SCIENCE ABSTRACTS.

Section A.—PHYSICS.

DECEMBER, 1931.

GENERAL PHYSICS.

4047. Manometer of High Sensitivity. K. Prytz. *Danske Vidensk. Selskabs., Med.* 11. 2. [46 *pp.*], 1931. *In French.*—The paper was written about May, 1928, and is now published by E. S. Johansen, the author having died on March 4, 1929. It describes a sensitive mercury manometer, in which the two limbs are rigidly attached to microscopes, and the adjustment is made by lowering or raising one microscope until the mercury is at a fixed distance below the objective. This adjustment is made optically and is sensitive to less than 1μ. The instrument has been applied to measure the pressure at the triple point of water. The results found varied from 4·5861 to 4·5875, with a mean of 4·5867 mm., but this was only intended as a preliminary value. J. H. A.

4048. Huygens' Manometer Adapted as a Tensimeter. B. Topley and M. L. Smith. *Journ. Sci. Instruments,* 8. *pp.* 194–196, *June,* 1931.—An accurate form of Huygens' manometer is described, with special reference to its use as a tensimeter. Difficulties due to irregularities of the cross-section of the manometer tube, in the graduation of the scale and in the glass of the air-thermostat window, and to deviation of the manometer and the cathetometer from the vertical are avoided by direct calibration against saturated water-vapour pressures over ice or water. Effects due to warping of the wood frame and support after calibration are avoided by a levelling device. The sensitivity is 0·001 mm. Hg, and the accuracy is limited by the degree of precision with which the temperature of the water or ice can be maintained and measured with the standardised thermometers usually available. AUTHORS.

4049. New Design of Ionisation Manometer. E. K. Jaycox and H. W. Weinhart. *Rev. Sci. Instruments,* 2. *pp.* 401–411, *July,* 1931.—Details are given of the construction, method of operation and characteristics of the gauge. It is used to measure the pressure of the residual gas in highly exhausted experimental tubes employed in the study of thermionic and photoelectric phenomena at pressures of 10^{-8} mm. Hg or lower. Its features comprise special insulation, high sensitivity, simplicity, reliability, freedom from Barkhausen oscillations and long life. It can be used safely to reduce the pressure in the tube by the clean-up process, since pressures can still be measured even if part of the filament burns out. R. S. R.

4050. Sensitive Membrane Manometer. K. Sommermeyer. *Zeits. f. phys. Chem.* 155. *Abt. A.* 3–4. *pp.* 208–210, *July,* 1931.—A membrane manometer is arranged as an electric condenser, the capacity of which changes with change of pressure. A sensitivity of 0·01 mm. is easily reached and an increase of this is considered possible. H. M. B.

4051. Circulating Pump for Liquids. D. R. Barber. *Journ. Sci. Instruments,* 8. *pp.* 183–188, *June,* 1931.—A description is given of a non-metal pump designed primarily for the circulation of electrolytes. The performance of the apparatus is discussed from a theoretical standpoint, and typical calibration curves obtained with an experimental pump are given. AUTHOR.

4052. Dependence of Quantity of Air Withdrawn by a High-Vacuum Pump on the Partial Vacuum. H. Ebert. *Zeits. f. Instrumentenk.* 51. *pp.* 337–341, *July,* 1931. *From the Reichsanstalt.*—A double-acting diffusion pump was used to determine the dependence of the volume of air flowing on the partial vacuum in the vessel. No dependence could be established for pressures over the range 0·001 to 0·5 mm. Hg. As soon as the preliminary vacuum pressure had reached that of the vapour pressure of the mercury in the vapour-pressure pipe the pump failed. R. S. R.

4053. Gravimetric and Magnetic Balance. G. Petrucci. *N. Cimento,* 8. *pp.* 205–212, *June,* 1931.—The theory of a balance is worked out, which can be used to measure variations in *g*. The essential parts are a vertical bar magnet and two horse-shoe magnets between which it swings, the centre of gravity of the bar magnet being above the horizontal axis about which it can turn. Theoretically, it should be able to detect variations of 10^{-7} cm./sec.^{2} in *g*, but this estimate takes no account of disturbances due to temperature inequalities. It is estimated that a reading would take only about 20 min. By use of auxiliary magnets, it would also be possible to use the same apparatus for measuring variations in the horizontal component of the earth's magnetic field, and in this case it is estimated that the accuracy would be as good as that obtained in the Schmidt magnetic balance. Both forms of apparatus are intended for use in geophysical surveying for minerals. J. H. A.

4054. Influence of Inaccurate Erection on the Sensitivity of a Moving-Weight Balance. K. Diehl. *Zeits. f. Instrumentenk.* 51. *pp.* 341–347, *July,* 1931.—The equilibrium conditions for a balance of this type are obtained when inclined to the horizontal. The equations indicate the variation of the sensitivity with load for different inclinations. Curves show the results of tests on a balance, and these agree well with the theoretical results. R. S. R.

4055. Chronograph Records. B. Berloty. *Bull. géodésique, No.* 29. *pp.* 1–5, *Jan., Feb., March,* 1931.—When auditory signals are received and recorded by the observer by tappings on a chronograph, experience shows that the observer rapidly falls into the rhythm of the signals. The problem of choosing the right part of the chronographic record for use is discussed. W. A. R.

4056. Time Standard of Extreme Constancy. O. Meisser and H. Martin. *Phys. Zeits.* 32. *pp.* 233–243, *March* 15, 1931. *Paper read before the Deut. Phys. Gesell., Dresden, Jan.,* 1931.—Various errors and corrections for a pendulum executing free vibrations are considered. Two pendulums under different conditions may be compared. A photographic method of obtaining coincidences between a pendulum vibrating freely and one maintained electrically is explained with the aid of diagrams. By this method, for the first time, it has been possible to compare two periodic motions with an exactness of 1 part in 10^7 for a time lasting 10 min. A free pendulum can also be compared with a tuning fork or a nickel-steel pendulum moving in the earth's magnetic field. The problem which now remains is to prove the constancy of the time standards over longer intervals. H. M. B.

4057. Simple Time-Integrating Device. A. G. G. Richards. *Journ. Sci. Instruments,* 8. *pp.* 225–226, *July,* 1931.—An instrument is described which has been constructed from a simple clock movement and an electromagnet. AUTHOR.

4058. Capillary Rise in Sands of Uniform Spherical Grains. W. O. Smith, P. D. Foote and P. F. Busang. *Physics,* 1. *pp.* 18–26, *July,* 1931.—Uniform spheres packed in regular array form a non-cylindrical cyclic capillary, characterised by a maximum and minimum capillary rise with intermediate positions of possible equilibrium. In practice spheres may be packed to a variety of porosities P, thus requiring a mixture of regular and irregular pilings arranged in a very distorted pattern. However, the meniscus is also distorted to conform in a general way with the distortions of the lattice. Accordingly positions of maximum and minimum rise may be expected. The meniscus for maximum rise tends to pass through the plane of centres of neighbouring spheres. Slight deviations from this condition due to the rise at sphere contacts are shown to be of minor importance. Any piling may be treated statistically as a hexagonal array with a spacing $2r + d$, where d is computed to give the observed porosity. In such a system three types of cell occur with a definite frequency, and these cell types are assumed present in the meniscus with the same frequency distribution. Hence it is possible to evaluate $pr/a = \rho ghr/\sigma$, where p = perimeter, r = grain radius, a = area of pore opening, g = acceleration of gravity, σ = surface tension, ρ = density, and h = capillary rise. The final formula so derived reduces to

$$pr/a = \rho ghr/\sigma = 2/\{[0{\cdot}9590/(1 - P)^{2/3}] - 1\}$$

This agreed with experiments made with several sizes of grains, porosities and liquids. The minimum rises were also determined, but a satisfactory interpretation in terms of a model has not been effected. AUTHORS.

4059. Effect of Light on the Surface Tension of Soap Solutions. L. D. Mahajan. *Indian Journ. Phys.* 6. *pp.* 147–154, *July* 31, 1931.—With the aid of a surface tension balance, and by the weighing method, the effect of the time for which Boys' soap solutions are kept in light on their surface tension is found. It is also found that the time for which the soap solutions are kept in a cool dark room has almost no effect on their surface tension. AUTHOR.

4060. Properties of a Hyperbolic Equation in Partial Derivatives. M. Brillouin. *Annales de l'Inst. H. Poincaré,* 1. 3. *pp.* 265–283, 1931.—Mathematical. Such equations are considered especially in their hydrodynamical applications. The case is treated in detail of the constrained oscillations in a heavy liquid in which a uniformly rotating sphere is immersed. H. F. G.

4061. Canal Waves of Permanent Type. W. Fenchel. *Accad. Lincei, Atti,* 13. *pp.* 740–743, *May* 17, 1931.—Wave motion in a canal is of permanent type if the free surface seems to move along the canal with a constant velocity without change of form. A simplification of the conclusions in Levi-Civita's paper on progressive waves of permanent type, *ibid,* Ser. 5, 16. pp. 777–790, 1907. A. D.

4062. Translato-Circulatory Current. A. Consiglio. *Accad. Lincei, Atti,* 13. *pp.* 866–868, *June* 27, 1931.—The author [*ibid.,* 11. pp. 813–818, *May* 4, 1930] calculated the resultant of the dynamical actions of a translato-circulatory current, irrotational and permanent, on a Joukowski pisciform obstacle. In the present paper the author calculates the strength of the same current under similar conditions. A. D.

4063. Vortex in Field Bounded by a Cardioid. B. Caldonazzo. *Accad. Lincei, Atti,* 13. *pp.* 869–873, *June* 5, 1931.—The above problem in hydrodynamics worked out. A. D.

4064. Vortex Motion behind an Elliptic Cylinder in a Stream and Some Allied Problems. S. Tomotika. *Phys. Math. Soc. Japan, Proc.* 13. *pp.* 191–200, *July,* 1931. *In English.*—A vortex-pair is assumed to be behind an elliptic cylinder in a streaming fluid from which discussions are made concerning its equilibrium positions and stability. The distribution of fluid pressure on the surface of the cylinder is also treated.
H. H. Ho.

4065. Mechanism of Vortex Motion behind an Elliptic Cylinder. M. Sanuki and H. Arakawa. *Phys. Math. Soc. Japan, Proc.* 13. *pp.* 201–207, *July,* 1931. *In English.*—It is shown that the vortex motion behind an elliptic cylinder can be deduced from that behind a circular cylinder, which is already known, by a method of transformation. The equilibrium positions of a vortex pair and the resistance experienced by the cylinder are also discussed. H. H. Ho.

4066. Loss of Energy at Impact of Two Confined Streams of Water. I. Naramoto and T. Kasai. *Kyushu Univ. Coll. Eng., Mem.* 6. 3. *pp.* 189–261, 1931. *In English.*—The impact of two streams of water in confined circular channels of 15–30 mm. dia. is examined experimentally. The suffix 1 referring to the primary stream, the suffix 2 relating to the impinging stream, m denoting the ratio of the areas of the primary and impinging streams, and θ the angle of impingement, the results indicate that the loss of energy at an elbow with a dead end in the line of the final direction of flow is given by $F \cdot v_2^2/2g$ as found by Gibson. When $m = 4$ the value of F for $\theta = 90°$ is smaller than that for $\theta = 75°$ and approximately equal to the value for $\theta = 60°$. When $m = 1$ then $F = 0{\cdot}00093\theta^{1{\cdot}58}$, and when $m = 1$ to 4, and $\theta = 90°$, $F = [(m - 1)^2/m^2] + 1{\cdot}1379/m$. The loss at a plain elbow is given by $F' \cdot v_2^2/2g$. When $m = 1$ and $\theta = 90°$, $F' = 1{\cdot}15$ and is intermediate between Gibson's and Weisbach's values, viz., 1·20 and 0·99. $F = F'$ when $m = 1$ and $\theta = 90°$. When $m = 1$ the loss per unit weight of total discharge varies linearly with $v_2^2/2g$. When $m > 3$, the loss per unit weight of impinging water varies linearly with $v_2^2/2g$. When m has a value between 1 and 3, the total loss of energy divided by $(Q_1^{1/m} + Q_2)$ varies linearly with $v_2^2/2g$, more especially when $v_2 > v_1$. Generally the loss of energy at impact can be represented by $(av_1^2/2g) + (bv_2^2/2g)$ per unit of $(Q_1^{1/m} + Q_2)$ when a depends on θ and m, and b depends on m when $\theta = 90°$, and upon m and v, when $\theta < 90°$. Values of a and b for $\theta = 90°$ are tabulated. The results differ from Gibson's in many respects and indicate that Gibson's results cannot be applied to conduits of circular cross-section. Differences in the widths of primary and impinging conduits produce a turbulent state of flow when the velocity of the impinging stream is very great and $\theta < 75°$. When $\theta = 90°$ or $< 75°$, and v_2 is small, differences of widths cause a decrease of the loss of energy at impact. J. S. G. T.

4067. Turbulence Circulation in Pipe Flow. H. Ertel. *Phys. Zeits.* 32. *pp.* 563–564, *July* 15, 1931.—In this entirely mathematical paper an expression is derived for changes in turbulence circulation. H. H. Ho.

4068. Characteristics of Flow at the Surface of an Aerofoil. M. Scott. *Physics,* 1. *pp.* 48–60, *July, and pp.* 94–100, *Aug.,* 1931.—The heat dissipation per unit area from the surface of model aerofoil is experimentally measured by means of narrow resistance strips mounted parallel to the span and flush with the surface. Results, covering variation with distance from the leading edge, with velocity as well as with change of angle of attack, show that the heat dissipation is in no simple way related to the velocity at the strip, as measured by the static pressure, but is evidently characteristic of the airflow at the surface. Further significance of the heat dissipation is sought. The relation of heat dissipation to viscous resistance (Reynolds' law) is discussed with relation to (1) two-dimensional flow between parallel plates, (2) a plane plate parallel to the flow and (3) the general case. It is concluded that the law is applicable to (1) and (2) but not to the general case. An integral relation is developed from which it is shown that the heat dissipation, as above measured, is proportional to the velocity gradient at the surface and hence to the viscous resistance. Curves present measurements made upon two aerofoils and these are briefly discussed. Experimental data are presented to show the changes in the heat dissipation for different parts of the airflow due to grids of varying fineness and spacing, due to changes of angle of attack and due to changes in location of the grids with respect to the aerofoil. In general, the heat dissipation is increased whenever a grid is present to induce turbulence in the air stream, and the effect is a maximum at about $0 \cdot 6\ x/c$. It is concluded that near the leading edge there exists a region that serves rapidly to damp the turbulence. AUTHOR.

4069. Influence of Temperature upon the Diffusion Coefficient of Solid Metals. C. Matano. *Kyoto Coll. Sci., Mem.* 14. *pp.* 123–130, *May,* 1931.—From the electrical resistance of foils composed of thin layers of two kinds of metals at various temperatures, the coefficients of diffusion D were determined successively by using the relation $Dt =$ const. for the same kind of foils, where t is a time interval which is necessary to bring their resistance to some fixed value, the portion of the resistance due to the coefficient of temperature being removed. By means of this method it was confirmed that the relations $D = Ae^{-a/\theta}$, and $D = A\theta e^{-a/\theta}$, where A and a are constants and θ is the absolute temperature, show equally well the experimental results for the Ag-Au system and for the Ni-Cu system between 300° C. (or 330° C.) and 500° C. AUTHOR.

4070. Flow of Gas through Porous Materials. M. Muskat and H. G. Botset. *Physics,* 1. *pp.* 27–47, *July,* 1931.—An experimental study has been made to establish quantitatively the characteristics of and laws governing the flow of gases through consolidated and unconsolidated porous materials of fine texture. Experiments were performed with columns of glass beads, homogeneous and heterogeneous unconsolidated sands, as well as with samples of actual sandstones. With the sandstones linear flows were made both perpendicular and parallel to the bedding plane. Radial flows through annular sections of the sandstone were also made. In all cases it was found that the gradient of the squares of the pressures is proportional to a power of the mass velocity. In the various cases the exponent was found to lie between the limits 1 and 2, corresponding respectively to a completely viscous and completely turbulent flow in straight cylindrical tubes. For a given sand, however, it remains fairly constant over a considerable range in the mass velocity. On the basis of these results a theory is developed for the production from and pressure decline in a closed sand reservoir of uniform thickness producing into a well under conditions of radial two-dimensional flow. The theoretical predictions check qualitatively with the limited field data that are available. AUTHORS.

4071. Stresses in an Elastic Sphere. B. Sen. *Calcutta Math. Soc. Bull.* 23. *pp.* 67–76, *June,* 1931.—The equations of equilibrium of an isotropic solid having symmetrical displacements about an axis are solved in terms of zonal harmonics. From this solution the distribution of stresses in a sphere are then worked out for the special cases of (*a*) two equal and opposite forces exerted at the poles; (*b*) normal pressures distributed uniformly over diametrically opposed spherical caps; (*c*) normal pressures distributed along the circumference of two small circles of latitude; and (*d*) normal pressures over the circumference of the equatorial section. It becomes possible to perform similar calculations for spherical shells. J. P. A.

4072. Elasticity of Spruce. H. Hörig. *Zeits. f. techn. Physik,* 12. 8. *pp.* 369–379, 1931.—After an extended series of measurements, Carrington [see Abstract 1514 (1923)] has suggested that the elastic properties of spruce are analogous to those of a rhombic crystal. The author reconsiders Carrington's data from this point of view. A more convenient arrangement of coordinate axes is chosen, and the elastic constants computed on the lines laid down by Voigt. The necessary assumption of the existence of an elastic potential is critically considered later in the paper. Formulæ and graphs are given which enable the elongations in any direction, the shears in any plane and the torsional displacements about any axis to be determined for a given set of forces. All the curves show that spruce is remarkably anisotropic, a fact which is indicated by the relative magnitudes of the linear compressibilities parallel to the chosen coordinate axes, *viz.*, 1×10^{-1}, 3×10^{-5}, $6 \cdot 7 \times 10^{-3}$, in the direction of the circumference, length and radius of the tree respectively. Poisson's ratios and volume compressibility are also calculated. Finally the physical significance of the results is discussed. J. P. A.

4073. Propagation of Waves in Isotropic Elastic Non-Homogeneous Media. G. Lampariello. *Accad. Lincei, Atti,* 13. *pp.* 856–860, *June* 5, 1931.—The longitudinal and transverse waves in an isotropic medium are studied mathematically, without restriction to plane waves. A further paper is promised in which anisotropic media will be considered. J. H. A.

4074. Dispersion of Energy from a Vibrating System. E. Volterra. *N. Cimento,* 8. *pp.* 217–232, *June,* 1931.—Investigates the general laws of vibration of reticular systems of elastic cords; then studies the dispersion of energy into supports constituted of cords of infinite length. A. D.

4075. Forced Vibration of an Elastic Rod. S. Higuchi. *Tohoku Univ., Sci. Reports,* 20. *pp.* 399–432, *July,* 1931.—The problem of the flexural vibration of an elastic rod clamped at one end and subjected to an internal resistance has been investigated; here a body of mass M is attached to the free end of the rod and an external damped periodic force acts on the clamped end, the rod initially having neither a displacement nor a velocity. The main properties of this type of vibration are fully discussed, including its various special cases. For the practical purpose, the convenient expressions for numerical solution are also obtained. In the course of the above-mentioned solution, roots of the so-called " characteristic equation " from the first to the fifth, by which the mode, the period and the damping constant, etc., of the natural oscillation are deduced, are calculated and tabulated. The case of various masses of the attached load is also treated. Using the above calculation, it is confirmed that if the internal resistance of a solid is assumed to be a fluid-like viscosity, the values of the coefficient obtained by Honda can be used in the practical calculation. AUTHOR.

4076. Dissipative Systems and Related Variational Principles. H. Bateman. *Phys. Rev.* 38. *pp.* 815–819, *Aug.* 15, 1931.—A given set of differential equations is always included in a set derivable from a variational principle. In the case of a set of equations representing a dissipative physical system the complementary set of equations may represent a second physical system, which absorbs the energy dissipated by the first. This is illustrated by an example in which the total kinetic energy is negative only when the initial conditions for the second system are related to those for the first. [See also Abstract 2927 (1931).] AUTHOR.

4077. Arrangement of Micro-Crystals in Compressed Single-Crystal Plates of Aluminium. Part III. Y. Fukami. *Kyoto Coll. Sci., Mem.* 14. *pp.* 97–113, *May,* 1931.—Experiments are described dealing with compression of a rectangular single crystal plate of Al to about 3 % to 10 % of its initial thickness. Four types of fibrous arrangement of the micro-crystals are discussed, two of which are of more frequent occurrence than the others. Their relation to the crystal planes is given in detail. For earlier work see Abstract 3330 (1930). F. I. G. R.

4078. Comparison of the Crystal Structures of Cu_5Zn_8 and Cu_5Cd_8. A. J. Bradley and C. H. Gregory. *Phil. Mag.* 12. *pp.* 143–162, *July,* 1931.—The structures of Cu_5Zn_8 and Cu_5Cd_8 are both of the γ-type, with 52 atoms to the unit cell, occupying very nearly the same general positions in each case. It is found that the structure of Cu_5Cd_8 is not analogous to those of the corresponding Ag-Zn and Au-Zn alloys. There is, therefore, no direct connection between chemical composition and atomic distribution in these alloys, although the general type of structure is the same. The analogy between the Ag-Zn alloy and Cu_5Zn_8 cannot, therefore, be relied upon as a sufficient method of determining the positions of the individual atoms of the alloy. It is believed to be correct, however, since Cu_5Zn_8 forms a continuous series of alloys with Cu_9Al_4, an alloy whose structure is definitely known. F. J. W.

4079. Crystal Structure of Tysonite (Ce, La, . . .)F_3. I. Oftedal. *Zeits. f. phys. Chem.* 13. *Abt. B.* 3. *pp.* 190–200, *July*, 1931.—Modifications, based upon new work, are suggested for the structure of tysonite. The elementary cell is hexagonal, containing 6 molecules: space-group D^3_{6h}. The usual parameters are: $a = 7 \cdot 124\ (\pm\ 0 \cdot 007)$ Å.; $c = 7 \cdot 280\ (\pm\ 0 \cdot 007)$ Å.; $c/a = 1 \cdot 022$. See also Abstract 485 (1930). F. I. G. R.

4080. Apparent Hemihedrism of Crystals of Lead Chloride and some other Salts. F. D. Miles. *Roy. Soc., Proc.* 132. *pp.* 266–281, *July* 2, 1931.—Lead chloride, which normally shows holohedral orthorhombic symmetry, can be obtained from hot aqueous solutions containing dextrin in microscopic crystals which are bisphenoids and can have only axial symmetry. By reducing the concentration of dextrin this form can be gradually repressed. Lead bromide and mercuric bromide also give examples of similar phenomenon. X-ray analysis of normal crystals of lead chloride indicates that the structure contains two glide planes of symmetry, and its symmetry is, therefore, probably holohedral. Evidence is brought to show that crystal faces lying opposite to each other across a plane of symmetry may behave differently from an optically active reagent. The examples described demonstrate that the presence of an optically active substance may induce the growth of a hemihedral crystal of a substance, the normal symmetry of which is certainly higher. F. J. W.

4081. Crystal Structures of the Hydrates of Copper Formate. K. J. Kabraji. *Indian Journ. Phys.* 6. *pp.* 81–114, *and* 115–132, *July* 31, 1931.—The two hydrates are monoclinic prismatic (holohedral). The crystal system of the anhydrous salt is unknown. The space-group for both the tetrahydrate and the dihydrate is C^3_{2h}, but the former has two molecules in the unit cell, and the latter four. The " length " of the water molecule is the same in both (4·22 Å.), and the structure of the formate group remains unchanged. The author discusses the condition of water of crystallisation, and its relation to the arrangement in ice. F. I. G. R.

4082. X-Ray Diffraction Pattern of Native Cellulose. U. Yoshida and N. Matsumoto. *Kyoto Coll. Sci., Mem.* 14. *pp.* 115–121, *May*, 1931. —The form of the crystallographic unit cell of native cellulose was examined by X-rays. Two diffraction spots on the equatorial layer line were discarded as not being of K_α origin, one being taken as of K_β origin and the other as due to the critical absorption edge of bromine contained in the sensitive film of the photographic plate as silver bromide. The lattice form was taken to be tetragonal, having the edges $a = b = 7 \cdot 79$ Å., and $c = 10 \cdot 26$ Å.; and 4 $C_6H_{10}O_5$-groups are supposed to be contained in a unit cell. AUTHORS.

4083. X-Ray Analysis of Slate. H. V. Anderson and K. G. Chesley. *Am. J. Sci.* 22. *pp.* 103–112, *Aug.*, 1931.—The existing views on the origin and formation of slate are very briefly given. Seven slates from different localities were examined by X-ray diffraction methods. A table giving the interplanar spacings in Ångstrom units, as obtained by the powder method, is given for all slate specimens and the principal spacings for minerals which were found to be present in slate. Evidence is given to show that former analyses reporting kaolin or andalusite in slate are in error and that the probable aluminium silicate present is cyanite. The preponderance of quartz, corundum, cyanite and mica in slate is established and small quantities of other minerals are indicated. Pin-hole diffraction patterns of two slate specimens are shown. A correlation of grain size with structural differences is attempted. A further proof that cleavage is due to orientation of the mica is also afforded. AUTHORS.

4084. Anisotropic Liquids (Liquid Crystals) in the Electric Field. W. Kast. *Zeits. f. Physik,* 71. 1–2. *pp.* 39–52, *Aug.* 4, 1931.—The Debye diagram of the effect of an electric field on anisotropic fluid *p*-azoxyanisole shows that the elementary particles of the melt possess a permanent dipole moment parallel to their (molecular) axis of about 10^4 times the amount of the molecular moment as an under limit. The picture is the same in the lower frequency alternating field, and diagrams are included for field strengths up to 300,000 hertz which show the various changes brought about. H. H. Ho.

4085. Micellar Structure of Graphitic Acid. H. Thiele. *Kolloid. Zeits.* 56. *pp.* 129–138, *Aug.*, 1931.—The marked laminar structure of graphitic acid is found to be sensitive towards mechanical effects (stirring, shaking, rubbing) and the structure of graphite determines that of the graphitic acid derived therefrom, *i.e.*, crystalline and amorphous graphites yield the respective acids. Crystalline graphitic acid behaves optically as a Wiener mixed layer substance, and in the direction of stratification exhibits double refraction at the longer dimension to its surface. In both water and other solvents of higher dielectric constant, swelling occurs which is reversible by all coagulating agents. Sol formation occurs spontaneously by extraction or shaking, and is favoured by ammonia, lower amines and traces of alkali. Sols are also formed in non-aqueous liquids such as alcohol, acetone, glacial acetic acid and acetic anhydride. The properties of the sols are discussed (colour, stability, etc.). Graphitic acid forms two kinds of colloidal solutions which differ as regards viscosity and optical behaviour, *viz.*, (1) suspensions; (2) micellar solutions. The sol particles wander to the anode in the electric field, *i.e.*, they possess a negative charge; the efficiencies of coagulating agents are discussed and it is found that of kations, $K < Ca < Al < Ce$. Micellar solutions with particles of very large surface and high viscosity are described. Graphitic acid is found to exert no protective effect, but is protected by starch and tannins. H. H. Ho.

4086. Molecular and Atomic Volumes. W. Biltz. *Zeits. f. phys. Chem. Bodenstein-Festband, pp.* 198–210, 1931.—The author confirms his former results. Further, for the half of all elements there is found to hold true an approximate expression $V_0 = 11\cdot 3n/N$, where V_0 = the null point atomic volume, n = the quantum number of the outermost electron orbit, and N the group number of the element in the periodic system. Thus there exist relations between the atomic physical data for isolated atoms and the occupation of space of the multiplicity of such particles of mass united together in a crystal. J. J. S.

4087. Effective Cross-Section of Gaseous Molecules for Slow Electrons. V. A. Bailey. *Phil. Mag.* 11. *pp.* 1052–1057, *May,* 1931.—An objection raised by Ramsauer to the method used by Townsend and Bailey for determining the effective cross-section of gas-molecules with respect to slow electrons is shown to be unfounded. The author criticises attempts made by Franck and Jordan to show that the collisions between slow electrons and helium atoms are perfectly elastic. Experiments performed by Townsend and Bailey show that the mean loss of energy in such collisions is not constant, as stated by Franck and Jordan, but diminishes as the energy of agitation of the electrons approaches the energy of agitation of the atoms of the gas. H. L. B.

4088. Angular Distribution of Scattering of Slow Electrons by Gas Molecules. C. Ramsauer and R. Kollath. *Ann. d. Physik,* 10. 2. *pp.* 143–154, *July* 3, 1931.—Experiments performed by the authors on He, A and H [see Abstract 3204 (1931)] have now been extended to include Ne, Kr, Xe, N, CO, CO_2 and CH_4. The results obtained for the gases previously investigated are confirmed. Further, it is found that at the lowest electronic velocities the " scattering ratio " may again increase (Xe, CO_2). Molecules which have a similar structure have similar curves for the scattering ratio as plotted against electronic velocity. H. L. B.

4089. Theory of Scattering of Slow Electrons by Atoms. W. P. Allis and P. M. Morse. *Zeits. f. Physik,* 70. 9–10. *pp.* 567–582, *July* 22, 1931.—To explain the Ramsauer–Townsend effect the diffraction of electron waves by atoms is calculated by the aid of an expansion in a series of spherical harmonics such as is used in optics to explain the colours of colloidal solutions. The atom is idealised into the form of a nucleus with a single electronic shell. Exchange phenomena are disregarded. The curves which represent the relation between the effective cross-section and the electronic velocity are for this model functions of two parameters β and r_0. Of these, β determines the curve-type. The curves are quasi-periodic in this parameter and the periods agree with those of the periodic system. r_0 determines the scale of both the cross-sections and the velocities. A method is given for calculating β and r_0 for any arbitrary atom. The theoretical curves show fair agreement in size and form with those obtained experimentally. H. L. B.

4090. Triatomic Hydrogen Ion H_3+. H. S. W. Massey. *Cambridge Phil. Soc., Proc.* 27. *pp.* 451–459, *July* 31, 1931.—In this mathematical paper the methods of quantum mechanics are applied to the study of a triatomic molecule and the simplest possible case of such, the ion H_3+, is dealt with. Hitherto no cases of systems with more than two nuclei have been considered, and the importance of nuclear symmetry has not been taken into account by Heitler and Rumer when dealing with polyatomic molecules. The author shows that nuclear symmetry considerations are the most important and decide the stability of the molecule. The addition of the third proton produces a much less stable compound with much wider nuclear separation. It is doubtful whether H_3+ should be regarded as a true homopolar compound or a polarisation compound. The comparative instability of the ion must be regarded as a consequence of proton spin. It is concluded from the calculations that nuclear symmetry considerations are of considerable importance in the theory of polyatomic molecules with similar nuclei. Thus molecules with three equivalent nuclei without nuclear spin like O_3 should be more stable than those with nuclear spin, such as N_3. J. J. S.

4091. Relative Abundance of Isotopes. H. C. Urey and C. A. Bradley, Jr. *Phys. Rev.* 38. *pp.* 718–724, *Aug.* 15, 1931.—The relative abundance of nuclei is often supposed to be related to nuclear stability.

Stability can be considered in two ways: on the one hand it may refer to a mixture in thermodynamic equilibrium; or, on the other, it is often used when referring to a system characterised by a slow rate of change to a thermodynamically stable state. It appears possible to test the hypothesis of equilibrium by a number of transmutation reactions. With the restriction to those reactions in which the same elements, differing only in mass, occur on each side of the equation, it is found that the thermodynamic calculations become very simple. The calculations are in agreement with the assumption that the atomic nuclei on earth do not represent an equilibrium mixture at any temperature. AUTHORS.

4092. Wave Theory of Matter. C. G. Darwin. *Annales de l'Inst. H. Poincaré*, 1. 1. *pp.* 25–31, 1931.—The author prefers the wave aspect of physical phenomena to that of particle dynamics. He shows that a wave function ψ can be found, from whose value in a special case Heisenberg's uncertainty principle can be deduced, if a certain variable used in a Fourier integral is interpreted as a "real" impulse coordinate. A method of finding the probability that the energy, momentum, etc., of an atom shall lie in given elementary domains is developed along with a method, different in form from one already given by Dirac, of finding variables suitable for transformation of the expression $\int |\psi|^2 dxdydz$. Difficulties connected with the dual aspect of physical phenomena are exemplified by the cases of a second collision of a pair of particles which have already met, and of the formation of trajectories in a Wilson cloud chamber. N. D.

4093. Problems of Quantum Mechanics. M. Born. *Annales de l'Inst. H. Poincaré*, 1. 3. *pp.* 205–264, 1931.—It is shown that the method of matrices can be applied to problems involving the statistical conception of quantum mechanics and to deduce Heisenberg's uncertainty principle. The radioactive disintegration of nuclei is discussed from the point of view of quantum mechanics, and relations similar to those due to Gamow and others are obtained. The problem of chemical catalysis by adsorption in solid bodies is considered in detail. The last section is devoted to the work of Weisskopf and Wigner on the width of spectral lines. N. D.

4094. Quantum Theory. P. Straneo. *Pont. Accad. Sci., N. Lincei, Mem.* 15. *pp.* 363–448, 1931.—A treatise, narrative and expository rather than mathematical. The subject is treated as follows: The necessity of an anti-classical hypothesis; the opportunity offered by Planck's quantum hypothesis. Divergences and approximations between the classical and the quantic physics. Development of the quantum theory up to about 1923, and the crisis which followed. Guiding idea, the development and interpretation of quantic mechanics; Dirac's theory. Bases and development of undulatory mechanics. Equivalence of the quantic and undulatory mechanics with the theory of Dirac. Physical interpretation of the undulatory mechanics: (*a*) the classical correlations between mechanics and optics; (*b*) the interpretation of the theory of Schrödinger; (*c*) de Broglie's contribution. Recent developments in quantic physics. Elementary indeterminism and its interpretation. A. D.

4095. Criticism of Dirac's Theory of Radiation. L. Rosenfeld. *Zeits. f. Physik*, 70. 7–8. *pp.* 454–462, *July* 14, 1931.—The failure of Dirac's radiation theory to determine the energy of a field of radiation is investigated mathematically, taking the special case of a unidimensional oscillator. N. D.

4096. Inner Degrees of Freedom of the Electron. E. Schrödinger and V. Fock. *Zeits. f. Physik,* 70. 11–12. *pp.* 808–810, *and p.* 811, *July* 29, 1931.—Schrödinger calls attention to a recent paper on the above subject by Fock, and claims that the mathematical treatment can be shortened by making use of a method described in a recent paper published by him. Fock, however, calls attention to the fact that the Schrödinger method is only applicable in cases where there is no external field of force, while the problem dealt with by him related to the spin in a magnetic field. Fock also claims that Schrödinger is wrong in thinking that the former has used the term *Zeitmittelwert* (average value over a certain time) in any unusual manner. H. N. A.

4097. Pictorial Representations of the Dirac Electron Cloud for Hydrogen-like Atoms. H. E. White. *Phys. Rev.* 38. *pp.* 513–520, *Aug.* 1, 1931.—Previous attempts to represent graphically the Schrödinger electron cloud for hydrogen-like atoms have been so successful that similar graphical representations have been looked for on the Dirac theory. With a single electron specified on Dirac's theory by a set of four wave functions instead of one, the probability density $\Psi\Psi^* = \psi_1\psi_1^* + \psi_2\psi_2^* + \psi_3\psi_3^* + \psi_4\psi_4^*$ is treated by considering, as on the Schrödinger theory, the independent angular and radial factors separately. Tables and graphs are given for $\Psi\Psi^*$ as a function of θ alone. The graphs are compared with and shown to correspond closely to the space quantisation of the classical electron orbits. Graphs representative of $\Psi\Psi^*$ as a function of r alone are given and compared with the electron-nucleus distances of the corresponding electron orbits. The radial and angular factors are brought together by means of a mechanical device described previously [see Abstract 3350 (1931)], which, when photographed, represents closely the electron cloud $\Psi\Psi^*$. Photographs are given for the states $1^2S_{1/2}$, $2^2P_{1/2,\ 3/2}$ $3^2D_{3/2,\ 5/2}$ $4^2F_{5/2,\ 7/2}$, and $5^2G_{7/2}$, with $m = \pm\frac{1}{2}, \pm\frac{3}{2}, \ldots \pm j$. AUTHOR.

4098. Exclusive Property of Ellipsoidal Homoïdes. P. Dive. *Comptes Rendus,* 193. *pp.* 141–143, *July* 20, 1931.—It is shown mathematically that any homoïde which exercises no attraction in its interior must be an ellipsoidal homoïde. R. S. R.

4099. Velocity of Propagation of Gravitation. E. Kogbetliantz. *Ann. de Physique,* 16. *pp.* 71–98, *July–Aug.*, 1931.—Objections to a finite value of the velocity of propagation of gravitational force have been advanced by Tisserand and by Chazy [see Abstracts 3944 (1930) and 1113 (1931)]. The author briefly discusses these objections, based on astronomical observations, and describes a suggested laboratory experiment, involving the use of a special form of torsion balance, with which, assuming the velocity of propagation to be finite and of the order of the velocity of light, it should be possible to establish the existence of a definite effect due to the finite character of the velocity, provided this effect is a first-order effect of the retardation of the gravitational action. J. S. G. T.

4100. Solution of Einstein's Gravitational Equations. O. K. Mitter. *Tohoku Math. J.* 34. *pp.* 110–114, *June,* 1931. *In English.*—The solutions are worked out of the equations $G_{\mu\nu} = 0$ for the case of symmetry about an axis. G. C. McV.

4101. Universe with Electrostatic Field. T. Takéuchi. *Phys. Math. Soc., Japan, Proc.* 13. *pp.* 179–182, *June,* 1931. *In English.*—It was sought to find a spherical universe in which there was an electrostatic field depending on distance from the origin alone. No solution of Einstein's gravitational equations for such a case could be found. G. C. McV.

4102. Entropy of Universe as a Whole. R. C. Tolman. *Phys. Rev.* 37. *pp.* 1639–1660, *June* 15, 1931.—On the basis of a relativistic extension of the second law of thermodynamics already developed by the author, it is shown that changes in a thermodynamic fluid may occur at a finite rate in the proper volume of the fluid, reversibility being maintained. Such changes are due to alterations in the gravitational potentials. The theory is applied to the case of an expanding (or contracting) universe filled with black-body radiation, and it is shown that the radius, total proper volume and entropy density of such a universe could be changing at a finite rate and yet reversibly without increase in entropy. An observer in such an expanding universe, who had access to a small part of it only, would conclude that there was a continual increase in entropy in the universe, owing to the apparent continual radiation from his immediate neighbourhood to other parts of the universe. G. C. McV.

4103. Unified Field Theory. A. Einstein. *Annales de l'Inst. H. Poincaré*, 1. 1. *pp.* 1–24, 1931.—A complete account of the recent developments of the author's unified theory of electromagnetism and gravitation, based on the concept of " parallelism at a distance " in a manifold with a Riemannian metric. G. C. Mc.V.

4104. Variability of Mass. C. Somigliana. *Accad. Lincei, Atti,* 13. *pp.* 804–809, *June* 5, 1931.—The concept of variability of mass is now generally associated with the relativistic form of the equations of motion of a point. The resulting mass depends on the square of the velocity according to some determinate analytical function. And it is found that many fundamental propositions of the ordinary dynamics remain valid even with this generalised form of the equations of motion. The question naturally arises, whether it may not be possible to construct a system of dynamics which shall retain the general lines of the classical dynamics without prescribing *a priori* any determinate form for dependence of the mass upon the velocity. The author works out an answer in the affirmative. Take the Hamiltonian integral $\int_{t_0}^{t_1} \mathrm{L}\,dt$ in which the Lagrangian function L has the form $\mathrm{L} = \frac{1}{2}\int_{a}^{v^2} f(v^2)\,d(v^2) - \mathrm{U}$, where $f(v^2)$ is an arbitrary function of v^2, a a constant and U the potential energy of the field in which the point moves. Derive the equations of motion by equating the differential of this integral to zero. We reach for the equations of motion

$$\frac{d}{dt}[xf(v^2)] = -\frac{\partial \mathrm{U}}{\partial x},\quad \frac{d}{dt}[yf(v^2)] = -\frac{\partial \mathrm{U}}{\partial y},\quad \frac{d}{dt}[zf(v^2)] = -\frac{\partial \mathrm{U}}{\partial z}.$$

These are satisfied by $f(v^2) = \dfrac{m}{\sqrt{1 - (v^2/c^2)}}$ which gives the usual relativistic equations of motion. A. D.

METEOROLOGY, GEOPHYSICS AND ASTROPHYSICS.

4105. Significance of Air and Sea Temperatures Obtained on Cruise VII of the "Carnegie." Katharine B. Clarke. *Monthly Weather Rev.* 59. *pp.* 183–185, *May,* 1931.—From May 1928 to Nov. 1929, air pressure, temperature and humidity and sea temperature were determined autographically and by direct measurement. The observations indicate that if radiation can be eliminated the mean daily air temperature seldom exceeds the mean daily sea temperature. To study the physical processes of the atmosphere, the author states that air temperatures must be accurate to 0·1° C. since the air and sea temperatures usually differ by less than 1° C. From temperature observations at 12, 72 and 113 feet above sea-level lapse rates several times the adiabatic rate for dry or saturated air were found. R. S. R.

4106. Oscillations of Solar Radiation in 135,000 Years and Its Results. W. Köppen. *Gerlands Beitr. z. Geophys.* 31. 1–3. *pp.* 231–239, 1931.—The secular change of earth radiation is expressed for each 5000 of the last 135,000 years for both hemispheres at 25° and 65° N. and S. for winter and summer. Periods of cold summers in the north show at – 23,000, – 72,000 and – 115,000 years. The oscillations of earth radiation are influenced by (1) the angle between the axis of rotation of the earth and the perpendicular to the plane of the earth's orbit, (2) the eccentricity of the earth's elliptic path, and (3) the time of perihelion. Curves show the secular changes of (2) and (3). The effect of these variations on glaciation and sea-level are discussed. R. S. R.

4107. Solar Irradiation of the Earth. R. Spitaler. *Gerlands Beitr. z. Geophys.* 31. 1–3. *pp.* 282–290, 1931.—By combining Hopfner's values of solar radiation with his formula for the distribution thereof, a simple formula is deduced giving a better result for mean temperatures, both annual and monthly, than the author, using Hopfner's formula only, obtained in his *Climate of the Ice Age.* These results are compared with those of Wiener and Milankovitch, and comparative tables are given. C. A. S.

4108. New Meteorograph with Radio-Transmitter. L. Heck and G. Sudeck. *Gerlands Beitr. z. Geophys.* 31. 1–3. *pp.* 291–314, 1931.—To obtain measurements of temperature, pressure and humidity changes with altitude, indications are transmitted by radio-telegraphy from the apparatus supported by the balloon to the observer. Two instruments are described in both of which the pointers indicating the changes of the three elements move over an arc of about 100° each around a circle and a time-impulse procedure is used to indicate the position of each pointer. In one case the rotating contact arm, which makes contacts with the pointers, controls a radio-transmitter directly in the plate circuit of the transmitting valve. In the other case a light ray scans the measured values and controls the transmitter by a selenium cell as a variable grid leak. The batteries used are especially light and insensitive to cold. The period of the impulse transmitted depends on the angular deflection. The impulse received at the ground is retransformed into a deflection of the recording instrument. A telephotographic receiver is adapted as the recording instrument and the diagrams can be observed during the ascent. The results obtained are to be communicated later. R. S. R.

4109. Application of Schuster's Periodograms. T. Banachiewicz. *Acad. Polonaise Sci. et Lettres, Bull.* 2A. *pp.* 112–116, *Feb.*, 1931. *In English.*—Schuster's periodograms for the coordinates of the pole have been calculated for the period 1899·9—1906·9, (i) from Witting's results, adopting for each coordinate terms representing the Chandler and annual periods; and (ii) using Krassowski's material [see Abstract 230 (1910)], but an improved method. The two results are very similar, but differ substantially from that of Krassowski. The annual period does not appear directly, but only Chandler's. C. A. S.

4110. Analysis of Latitude Variation. A. Schedler. *Gerlands Beitr. z. Geophys.* 31. 1–3. *pp.* 217–230, 1931.—If $r = \sqrt{(x^2 + y^2)}$, where x and y are Pollak's rectangular coordinates of the Pole, be plotted against time, a 6-year period appears, overlaid by an approximately half-year period the amplitude of which varies, being a maximum when the 6-year period of r is a maximum. The real as well as the mathematical existence of such a half-year period is demonstrated. It is then shown that the period of a complete cycle of r is the Chandler period of 1·192 years, which, however, varies about this mean value with a period of six years, being a maximum in the fifth year of the cycle (counting from 1890·0). Finally it is concluded that these variations in the Chandler period are purely mathematical and hypothetical. The half-yearly variations of polar altitude coincide with half-yearly pressure variations at Vienna. C. A. S.

4111. Clairaut's Formula for the Variation of Gravity with Latitude. A. Fasching. *Bull. géodésique, No.* 29. *pp.* 6–19, *Jan.–Feb.–March*, 1931.—It is shown that Clairaut's formula is the basis of many fundamental geodetic relations, and this has hitherto not been made evident. The deductions arrived at support Clairaut's historic contention that " the question of the figure of the earth is the question of the law of gravity." W. A. R.

4112. Regional Isostatic Reduction of Gravity Value. F. A. V. Meinesz. *Bull. géodésique, No.* 29. *pp.* 33–51, *Jan.–Feb.–March*, 1931.—The author proposes a method of reduction based on regional compensation as easy to apply as the Bowie-Hayford method based on local compensation. Topographic masses above sea-level are considered as additions to the earth's crust, which is by their weight pushed downwards into the viscous substratum. On these assumptions and treating the crust as elastic, a factor is obtained which, multiplied by the mean height of zones around the geodetic station, gives by simple tabulation the reduction desired. W. A. R.

4113. Unsolved Problems of Classical Mathematical Physics. M. Brillouin. *Annales de l'Inst. H. Poincaré*, 1. 3. *pp.* 285–308, 1931.—Among the calculations left incomplete by investigators of the last century, that dealing with the formation of the earth's crust by solidification is one of the most outstanding. This paper attempts a nearer approach at solution. In Neumann's problem, in which the plane surface of an infinite isothermal column of water is suddenly reduced to a temperature below the freezing point, the depth z of the ice-water surface at a subsequent time t is already known to be $z = \alpha\sqrt{t}$; but the properties of the function α

are discussed for the first time here. The problem of a finite layer of ice in contact with a finite layer of water, with arbitrary temperature distributions, is then formulated mathematically. In order to employ known integrals it becomes necessary to introduce four unknown functions which continue the temperature distribution to $\pm \infty$ in both layers. For these four functions, and for the law of solidification, five integral equations are found, of which only two are of known form. As particular examples, (*a*) Stefan's problem, where two infinite, isothermal layers, one of ice, one of water, suddenly meet in a plane, and (*b*) Neumann's problem, are worked out and shown to give the known solutions under certain conditions. The problem (*c*) of the "wall of water," and (*d*) the analogous spherical problems, are formulated and shown to be as yet insoluble.
J. P. A.

4114. Thickness of the Continental Layers of Europe. R. Stoneley. *Roy. Astron. Soc., M.N. Geophys. Supplement,* 2. *pp.* 429–433, *June,* 1931.—In the Kew seismograms of earthquakes of which the waves arrive in an easterly azimuth (*e.g.*, two with epicentres at 3·0° S., 100·9° E. and 28·5° N., 56·0° E.), the Love and Rayleigh waves are easily separated. From the Love waves of group velocities > 3·7 km./sec., the thickness of the granitic layer (assumed as half that of the intermediate layer) is deduced as 12 km. If waves of group velocities > 3·5 km./sec. be used, which would require consideration of the sedimentary layer also, a thickness of 13 km. results.
C. A. S.

4115. Origin of Continents. J. Geszti. *Gerlands Beitr. z. Geophys,* 31. 1–3. *pp.* 1–39, 1931.—The theory of molten silicates is used to explain the origin of a thermally insulated layer which sinks in the main magma, accelerates the coagulation of the liquid above and allows a temperature difference to arise at the earth's surface and so starts and furthers the surroundings of the masses which are the origin of the continental blocks. This thermally insulated layer consists initially of crystalline precipitates relatively difficult to melt, which, with the solid layer above, protects the easily melted rocks of the earth's crust before the initial melting. The stability of the crust is safeguarded by the lowest layer, which is difficult to melt. The size of continents is limited by (1) the regional distribution of admixture in the main magma, (2) the possibility of the equalisation of the existing temperature differences and (3) the precipitation of the water vapour from the gaseous envelope by the weight of the collected water mass of the oceans. The thickness of the crust depends on (1) the increase of density of the initially precipitated crystals with phase change, (2) the density and viscosity of the liquid in which the crystals sink and especially (3) the melting point of the initial precipitates. [See Abstract **67** (**1931**).]
R. S. R.

4116. Constitution and Astronomical Refraction of the Aerosphere. F. Wünschmann. *Gerlands Beitr. z. Geophys.* 31. 1–3. *pp.* 83–118, 1931.—The general stratography of the aerosphere and the run of optical surfaces as indicated by registering balloons are first considered. The absolute topography over middle Europe of surfaces of equal refractive index are obtained and the inclination of the optical surfaces according to charts and Harzer's formula. These show that the differences caused by deviations from the shape of concentric spherical surfaces are determined in sign and amount by the run of the optical surfaces in the lower layer of the stratosphere, *i.e.*, approximately between 15 and 44 km. in height.

Since the mass distribution in these layers is not known exactly, the corrections to refraction values are uncertain. The influence of discontinuities and orographic anomalies are considered as sources of error. Earth tremors and the direct influence of the flowing air cause a tilting of the instrument and corrections are considered for unavoidable vibrations of the telescope. The choice of an unsuitable site for, and architecture of, the observatory and the construction and support of the instruments are of importance. Temperature variations in the light path in the observatory cause a disturbance, and refraction in the telescope causes errors not yet found. R. S. R.

4117. Electrical Resistivity and Induction Measurements at Abana Mine, Quebec. B. E. V. Potter and F. W. Lee. *Bureau of Mines, Techn. Paper, No.* 501. [28 *pp.*], 1931.—A detailed account is given by Potter of surveys of the Abana mine (Abilihi county, Quebec), the ores of which are mainly pyrite, chalcopyrite and sphalerite, by (i) a resistivity method (the megger), and (ii) an a.c. method (Bieler and Watson's). The results agree well with known facts, indicating both the known ore bodies. The resistivity method gives greater detail but is slower; the a.c. method being more rapid is better suited for a preliminary survey. This is followed by a theoretical calculation by Lee of the relation between currents and magnetic fields, and the interrelation of parameters in an ideal induction method, with a simple specification of a measuring circuit. C. A. S.

4118. Development of the Wave Conception. Part VI. K. Uller. *Gerlands Beitr. z. Geophys.* 31. 1–3. *pp.* 40–82, 1931.—This mathematical paper continues the general investigation of the wave conception [see Abstract 2611 (1931)] as follows: Section 1 deals with consequences from the invariance of the wave phase in moving media; invariance of the wave normal pair and Doppler-effect in the wave in the case of elementary fluctuation; Section 2 examines the coherence of the wave-phase; Section 3 considers the relative Doppler-effect at moving surfaces of instability; Section 4 investigates kinematic propositions of wave-incidence; Section 5 for waves propagated in homogeneous media; Section 6 contains the condition for the simple wave; Section 7 compares the false and true theory of wave-incidence; and Section 8 derives the energy motion in a wave. H. H. Ho.

4119. Tidal Oscillations in Rotating Rectangular Basins of Uniform Depth. S. F. Grace. *Roy. Astron. Soc., M.N., Geophys. Supplement,* 2. *pp.* 385–398, *June,* 1931.—The general problem of forced tides in a rotating rectangular basin is tackled by a method of analysis differing slightly from that used by G. I. Taylor. Approximate solutions are given for deep basins, for forced tides in a rectangular lake and also for co-oscillations of a rectangular gulf when there is a uniform periodic current across the mouth. Comparison is made between these expressions and the application of " narrow sea " methods. Both are found to imply a small correction to the equilibrium form, but the corrections are different. The results are discussed in the particular case of the Black Sea spring tides. W. A. R.

4120. Times of P and S at Short Epicentral Distances. H. Jeffreys. *Roy. Astron. Soc., M.N., Geophys. Supplement,* 2. *pp.* 399–407, *June,* 1931.—Using the data and method previously described (*ibid.,* 2. pp. 329–349, 1931), but treating together residuals over a range of 2·5°

only, for $\Delta < 25°$ the times of transmission for P and S apart from constant terms are given by $T_P = 14 \cdot 30\,\Delta - 2 \cdot 00(\Delta/10)^3$ and $T_S = 25 \cdot 70\,\Delta - 3 \cdot 50(\Delta/10)^3$. P and S within this range are usually followed by other pulses, due possibly to internal reflection in the upper layers, at intervals of about 8 sec., confusion with which may explain some observations otherwise inexplicable. C. A. S.

4121. Cause of Oscillatory Movements in Seismograms. H. Jeffreys. *Roy. Astron. Soc., M.N. Geophys. Supplement,* 2. *pp.* 407–416, *June,* 1931.—No form of dispersion in the bodily waves, whether due to heterogeneity of the earth's composition, gravity or friction [see Abstract 1824 (1931)], can give rise to a long train of oscillations, and so explain the vibrations occurring before the arrival of any surface waves. These oscillations must be due to reflections of the original pulse within the surface layers, being partially refracted into the lower layer at each arrival there [see Abstract 2284 (1926)]. The first pulse to arrive must be the true P. C. A. S.

4122. Theory of the Galitzin Seismograph. J. Rybner. *Gerlands Beitr. z. Geophys.* 31. 1–3. *pp.* 259–281, 1931. *In English.*—The investigation is based on Wenner's results [see Abstract 3503 (1929)] with the aid of Heaviside's operational calculus. The theory of the seismograph is first deduced, assuming the natural periods and damping coefficients of pendulum and galvanometer to be equal, and is then extended to the general case. This is followed by a method for determining the constants and a note on the use of an electrical network on the galvanometer circuit. Numerous illustrative curves are given. C. A. S.

4123. Bibliography of Seismology. E. A. Hodgson. *Dominion Observat. Ottawa, Publ.* 10. 7. *pp.* 103–118, *July, Aug., Sept.*; 10. 8. *pp.* 121–138, *Oct., Nov., Dec.,* 1930; 10. 9. *pp.* 141–155, *Jan., Feb., Mar., and* 10. 10. *pp.* 159–173, *April, May, June,* 1931.

4124. Earthquake Near Imotski, Yugoslavia, March 15, 1923. E. Tillotson. *Roy. Astron. Soc., M.N. Geophys. Supplement,* 2. *pp.* 416–429, 1931.—Examination of eleven seismograms of the Imotski earthquake for places with $\Delta < 20°$, shows the epicentre to be at 43° 37·8′N, 16° 47·4′E. The P, P^*, P_g, S, S^* and S_g pulses are verified, and also P_s, the possible compressional wave in the sedimentary layer, with its possibly corresponding S_s, and indications found of two more pulses immediately following P and S respectively. Equations for the first 20° of all are deduced and tables evaluated, the travel times of P agreeing best with Jeffreys' tables. The thicknesses of the sedimentary, granitic and intermediate layers deduced are respectively 4, 13 and 25·3 km., the focus being 12 km. below the top of the granitic layer. The energy of the earthquake is approximately 10^{21} ergs. C. A. S.

4125. Spectroscopic Investigations of the Sun. Device and Tables for Computing Components of Orbital Velocity of Earth to Points on Sun. R. E. de Lury. *Dominion Obs. Ottawa, Publ.* 6. *pp.* 57–67, 1931.—Duner's table gives only points on the solar limb relatively to the centre; the Ottawa observations include, however, not only spectra from pairs of points within the limb, but also from the centre and intermediate position, and from laboratory sources for determining spectrum wave-lengths and their variations for individual solar points. The tables give (1) angle between the radius vector and the normal to the earth's orbital motion; (2) difference between components of earth's orbital velocity to solar centre and limb points on the ecliptic; (3) difference between components of earth's orbital velocity to solar centre and limb points; (4) angle between ecliptic and solar disc equatorial diameters; (5) components of earth's rotational velocity to the sun's centre for Ottawa [this formula, $0\cdot3263 \cos\delta \sin t$ km./sec., can be used for another observatory by multiplying δ and t values by the appropriate factor]. A plate and description is given of a device for computing the components of the orbital velocity of the earth to points on the sun in connection with these tables. A. S. D. M.

4126. Spectrohelioscope and Its Work. Part III. Solar Eruptions and Their Apparent Terrestrial Effects. G. E. Hale. *Mt. Wilson Observat., Contrib. No.* 425. *Astrophys. J.* 73. *pp.* 379–412, *June*, 1931.—In co-operative observations with the spectrohelioscope, to be made at many stations distributed around the world, occasional violent eruptions on the sun's disc call for first attention. Many of these phenomena are described and illustrated in this paper. Most of them were photographed with the spectroheliographs of the Kenwood, Yerkes, Mount Wilson, South Kensington, Kodaikanal, and Meudon Observatories, which should be used in connection with the chain of spectrohelioscopes for their detection and study. Several of these eruptions were followed after an (average) interval of about twenty-six hours by violent terrestrial magnetic storms and brilliant auroræ. The principal theories of these phenomena, all of which ascribe them to the influence of solar disturbances, are briefly outlined. The paper includes a list of the twenty-three widely distributed observatories where spectrohelioscopes are already in use or will soon be erected. Other spectrohelioscopes will be available later at additional stations. It will thus be possible to inaugurate a comprehensive series of observations under the auspices of the International Astronomical Union. [See also Abstract 3365 (1930).] AUTHOR.

4127. Formation of Magnesium *b*-Lines in the Solar Atmosphere. H. H. Plaskett. *Roy. Astron. Soc., M.N.* 91. *pp.* 870–933, *June*, 1931.—Photographs are taken of the Mg *b* absorption lines across the solar disc. The plates are measured with a Moll microphotometer and, after the application of various corrections, values of r, the ratio of the intensity in the line to that in the adjacent continuous spectrum, are determined with a maximum error of $\pm 5\,\%$. The observed variation of the contours of the lines across the solar disc is compared with the predictions of models of pure absorption, pure scattering and combined scattering and absorption. Only the latter model, due to Eddington, satisfactorily represents the observations. The verification of the Eddington model has five consequences, (i) atoms which absorb radiation off the line centre, remit the radiation, at least statistically, in the same frequency; (ii) the lifetime of an atom in the excited state increases from the line wings in towards the centre, with the result that collisions of the second kind also increase in the same direction; (iii) the spectroheliographic observation of faculæ in the wings of lines, up to the centre of the solar disc, is accounted for; (iv) the Eddington model and Born's collision theory accounts in detail for the observed limb spectrum; (v) according to the theory of line absorption developed in this paper it is impossible to determine the number of atoms from the strength of an absorption line without knowing in detail the physical conditions of the stellar atmosphere. J. E. K.

4128. Temperature of Photosphere. F. Baur. *Zeits. f. Astrophysik,* 3. 1. *pp.* 26–30, *June* 29, 1931.—In the determination of the temperature of the photosphere from the position of the maximum of the energy-curve, allowance must be made for the displacement of this maximum towards short wave-lengths through absorption of part of the radiation in the sun's atmosphere. If the temperature is found from the intensity of the radiation, a correction must again be made to account for the radiation that is reflected back on to the photosphere by the sun's atmosphere. The values obtained by both methods, with these corrections, agree in giving a temperature of 5960° to 5950° Absolute for the photosphere. G. C. McV.

4129. Contour of the Helium Line λ5876(D_3) in the Spectrum of the Sun's Chromosphere. A. Unsöld. *Zeits. f. Astrophysik,* 3. 1. *pp.* 77–80, *June* 29, 1931.—In a previous paper [see Abstract 2696 (1929)] it was inferred from measurements of the distribution of intensity in the H- and K-lines of Ca^+ that the upper layers of the chromosphere are permanently in a vehement irregular state of motion with a mean velocity of 15 km. per sec. The distribution of intensity in the D_3-line of He, λ5876, is now measured and leads to the conclusion that the He in the chromosphere possesses the same irregular motion as Ca. J. E. K.

4130. Meteor Statistics. E. Öpik. *Harvard Coll. Obs., Circ. No.* 355. *pp.* 1–12, *Oct.* 4, 1930.—The usually accepted theory which deduces from meteor counts their average velocity is in error, because the influence of velocity upon their apparent brightness has been neglected. A new theory is proposed, and observational tests are discussed. If meteors are of solar origin, the directions are very unevenly distributed, with a preference for direct motion. Mere counts of frequency cannot give reliable data concerning their cosmic origin: only detailed statistics of direction can be of real use for this purpose. M. A. E.

4131. Meteor Heights from Photographs. Margaret Olmsted. *Harvard Coll. Obs., Ann.* 87. 2B. *pp.* 222–229, *June* 1, 1931.—A method is described by which the geocentric path of a meteor photographed simultaneously at two different stations can be accurately calculated. M. A. E.

4132. Interpretation of Lunar Maps. P. Humbert. *Pont. Accad. Sci., N. Lincei, Mem.* 15. *pp.* 333–343, 1931. *In French.*—From a study of lunar maps reasons are given for believing that lunar craters are due to the collision of meteors with the moon. G. C. McV.

4133. Orbits of the Planets Neptune and Pluto. G. Fayet. *Comptes Rendus,* 193. *pp.* 144–146, *July* 20, 1931.—Adopting the heliocentric elements of the new planet given by Nicholson and Mayall and neglecting perturbations, the circumstances of successive heliocentric conjunctions of the two planets are found. In a table is given the years for this occurrence from 2921 B.C. to A.D. 7293, the interval being a little below 500 years. For two of these, 1528 B.C. and 1048 B.C., there are two supplementary conjunctions. R. S. R.

4134. Objective Prism for Radial Velocity Measures. P. M. Millman. *Harvard Coll. Obs., Circ. No.* 357. *pp.* 1–14, *May* 1, 1931.—The advantages of an objective prism over a slit spectrograph are the possibilities of studying fainter stars with small instruments and of photographing many spectra in one exposure. The results cannot be as accurate, but radial velocities of faint stars in great number and of approximate accuracy are urgently needed for statistical investigations. The best methods and design of instrument are discussed. M. A. E.

4135. Variable Star T Centauri. Augusta H. Morse. *Harvard Coll. Obs., Circ. No.* 358. *pp.* 1–13, *May* 1, 1931.—The period of this star varies irregularly from 84 to 103 days; the maximum brightness from 7^{m} to $7^{m}\cdot 4$, and minimum brightness from $8^{m}\cdot 9$ to 10^{m}. Individual light-curves differ considerably in shape, some showing a resemblance to the typical type along part of their length and then turning abruptly, as if some additional change were superimposed. The star is redder at some minima than at others. There seems to be no regular order of occurrence of deep and shallow minima, and no connection of range with period. Changes in radial velocity, when compared with the light curves, show that the maximum rate of expansion occurs at the time of maximum light, and greatest speed of contraction at the time of minimum light. M. A. E.

4136. Temperature of 142 Stars Near the North Pole. Georgette Maulbetsch. *Harvard Coll. Obs., Circ. No.* 360. *pp.* 1–10, *May* 20, 1931. The spectrophotometric method of determining stellar temperatures gives results which prove that it may safely be used for statistical work. In this catalogue the spectral class, magnitude, gradient, and temperature is given for each star. Spectrophotometric gradients increase in absolute value from early to late type stars, and when giants and dwarfs are compared, the dwarfs are always hotter. M. A. E.

4137. Scorpio-Centaurus Cluster. Parts I and II. C. Jane Anger, Cecilia H. Payne and Georgette Maulbetsch. *Harvard Coll. Obs., Circ. Nos.* 363 *and* 364. [20 *pp.*], *June* 5 *and* 24, 1931.—This cluster contains about 200 bright-line B stars, and their absolute magnitudes have been determined from measures of line intensities in their spectra. These agree nearly with the absolute magnitudes derived from the group motion. Line intensity is more closely correlated than spectral class with absolute magnitude, and the relation of line intensity with spectral class is found to differ for different clusters. A space survey of the cluster has been made. Struve attributed bright lines in B stars to rapid axial rotation, but it is difficult to reconcile this with the characteristics of the absorption lines, and the spectra and other properties of these stars suggest that a solution must be sought in physical rather than mechanical theory. M. A. E.

4138. Spectroscopic Determination of Distances of Five Galactic Clusters. C. Jane Anger. *Harvard Coll. Obs., Circ. No.* 362. *pp.* 1–12, *June* 15, 1931.—The relationship of hydrogen line intensity with absolute magnitude described in a previous paper [see Abstract 415 (1931)] has been investigated further, and the difference formerly found between the mean curves for the Pleiades and Messier 7 is explained by a scale error in the magnitudes for Messier 7. Measures of line intensity have been made in the Scorpio-Centaurus, Ursa Major, Orion, Pleiades, Messier 6 and 7 clusters, and spectroscopic parallaxes have been derived. M. A. E.

4139. Light Curves of Peculiar Variables, 1930. L. Campbell. *Harvard Coll. Obs., Circ. No.* 361. *pp.* 1–8, *June* 27, 1931.—Tables and light-curves are given, summarizing the observations during the year 1930 of three variables of SS Cygni type and six of R Coronæ Borealis type.

The latter star has now remained for six years at practically normal maximum with little if any change in magnitude. R Scuti passed through three deep minima during the year. M. A. E.

4140. Observed Maxima and Minima of Variable Stars for 1930. L. Campbell. *Harvard Coll. Obs., Circ. No.* 367. *pp.* 1–8, *June* 30, 1931.—This includes nearly 400 stars of long period, chiefly of spectral class Me, with a few N and R. M. A. E.

4141. Absolute Magnitudes of the Cepheids. G. Cecchini. *Accad. Lincei, Atti,* 13. *pp.* 874–878, *June* 5, 1931.—The general accuracy of the period-luminosity curve of Cepheids is well established, but there is a discontinuity at the 10-day period, the extension of the law from galactic to extra-galactic Cepheids needs particular caution, and the results of research by several different investigators using different methods suggest that a correction of the zero point is necessary. A recent study of parallactic movements confirms this, and it follows that the luminosity of the Cepheids is less than supposed by Shapley, and that the distance of every celestial object calculated from his curve ought to be reduced by a factor of 0·6. M. A. E.

4142. Periodic Variable Stars. K. Hirayama. *Imp. Acad. Tokyo, Proc.* 7. *pp.* 247–250, *July,* 1931. *In English.*—An explanation of variable stars based on the idea that they all are binary systems. Cepheids consist of a contact system formed by a giant and an almost dark dwarf. A Mira-type variable consists of a very bright star and dark companion, the latter moving within a nebulous envelope surrounding the former. G. C. McV.

4143. Stellar Parallaxes Determined Photographically at the Cape Observatory (Third List). R. Dyson. *Roy. Astron. Soc., M.N.* 91. *pp.* 822–828, *June,* 1931.—The stars are numbered in rotation from 215 to 315, in continuation of the two previously published lists. Two values of proper motion in R.A. are given, one based on meridian observations or comparison of photographic plates, the other derived from the parallax plates. The proper motion in declination is based on meridian or other observations. These will be determined later, by comparing photographs of each region with a time interval of five years. M. A. E.

4144. Interlocking of Triplets of Absorption Lines. R. v. d. R. Woolley. *Roy. Astron. Soc., M.N.* 91. *pp.* 864–870, *June,* 1931.—In a previous paper [see Abstract 788 (1931)] the author found that the widths of two interlocked principal absorption lines were unaffected by the interlocking. The investigation is here extended to the widths of interlocked triplet lines with a common upper level such as the $2^2S - 2^3P_{2,1,0}$ triplets of the alkali earths. It is found that interlocking does not affect that part of the contour which lies above the ordinate $H'_\gamma/H = \frac{7}{10}$. The central portions of the line show large interlocking effects. The effect of interlocking is in the reverse sense to that hitherto expected, the strongest line being strengthened and the weakest one partly filled up. J. E. K.

4145. Faint Stars in Selected Areas with Large Proper Motions. H. Knox-Shaw and H. G. S. Barrett. *Roy. Astron. Soc., M.N.* 91. *pp.* 933–937, *June,* 1931.—A revised list of the stars from 51 of the selected areas with proper motions as large as $0''\cdot 1$ is given, after allowing for an error in the proper motions depending on a magnitude equation. The results for a further 22 of the selected areas are also given. Down to a limiting magnitude of 15·3, 101 stars, out of 21,070 measured, were found to have proper motions as large as $0''\cdot 096$. The lists are published by the Radcliffe Observatory, Oxford. G. C. McV.

4146. Effect of Atmospheric Absorption in Stellar Spectrophotometry. W. M. H. Greaves. *Roy. Astron. Soc., M.N.* 91. *pp.* 938–941, *June*, 1931.—In reply to Dufay [see Abstract 2632 (1931)], it is true that the atmospheric absorption is not a linear function of the reciprocal of the wave-length, but provided the absorption is derived from measures at the same wave-lengths as those used for the gradients to which it is to be applied, no inaccuracy is introduced into the final results of colour-temperature observations by solving the absorption measures for a linear gradient. The curvature becomes important only when investigating the closeness with which the energy distribution of the stars conforms to the black-body law. It then becomes necessary to evaluate for each wave-length the residuals from the derived gradient between star and standard source, and to correct them by the corresponding residuals of the absorption measures. This is in effect what Dufay recommends, except that it is applied, not to the original measures, but to the residuals of the least-square solutions for linear gradient. M. A. E.

4147. Velocity Curve of 27 Canis Majoris. O. Struve. *Astrophys. J.* 73. *pp.* 301–307, *June*, 1931.—This interesting star has a period of 2000 days or more, and an amplitude of 220 km./sec. The minimum mass is 2000 times that of the sun, which far exceeds that of any known binary. The bright components of the H lines, and also the absorption lines, show variations in intensity which are related to the period of the velocity curve. M. A. E.

4148. Spectrum of H.D. 50138. P. W. Merrill. *Mt. Wilson Observat. Contrib. No.* 423. *Astrophys. J.* 73. *pp.* 348–368, *June*, 1931.—A study of 75 plates between December 26, 1920, and February 15, 1930. A table is given of the H, He, Mg and Fe lines and their displacements (which are not all the same); Hβ is broad, weak and dark with two superposed bright lines of which E*r* is strong and stable in intensity, and E*v* varies from very weak up to E*r*'s intensity; the other lines are wholly dark. Hβ and Hδ have practically the same displacement and their mean values (μ) have been taken as the standard. The systematic difference, $\mu - H\beta$, is + 9·8 km./sec., and the average difference (without regard to sign) is 11·6 km./sec. If μ is small, Hβ gives smaller displacements; if it is big, Hβ gives nearly the same values; Hβ displacements cannot therefore be combined with those of other H lines. He 4471 and Mg 4481 behave alike, but have little in common with H lines. The behaviour of Fe lines is between the H lines and that of He 4471 and Mg 4481, but has a decided progression with μ. H and K(Ca) and D_1 and D_2(Na) are probably stellar in origin and not detached. The intensities of the Hβ components behave as the displacements do, and perhaps the central absorption at Hβ is merely a minimum between the emission lines; possibly the weak emission edges to Hγ behave like those of Hβ. The author discusses whether the E*r* changes are due to absorption, as in the central dark lines of the Balmer series, or to hiding by the approaching limb of a rotating star, and he compares the behaviour of H lines to that in Mira's companion. The periodicity in E*v* may be due to a compound of 5-year and 330-day cycles, the latter being perhaps the period of the variable star. A. S. D. M.

4149. Spectrum and Radial Velocity of AC Herculis. R. F. Sanford. *Mt. Wilson Observat. Contrib. No.* **424**. *Astrophys. J.* 73. *pp.* 364–378, *June*, 1931.—The author discusses the work of (Miss) Applegate and Leiner, Zacherov and Waterfield, and adopts the latter's representation: Light min = J.D. 2414461·1 + $75^d\cdot4E$ + $6^d\cdot1 \sin(157°\cdot5 + 2°\cdot045E)$ G.M.T. Graphs are given of Leiner's visual and Waterfield's photographic light-curves, estimated spectral types, and individual velocities from arc and enhanced lines. The star has a period of about 75 days with two maxima and two minima with a variable shape of light curve, the ranges in photographic and visual light curves showing an increase of about 2 spectral divisions between maximum and minimum light (F8 to K5). A table is given of 72 spectrographs (October 7, 1924, to September 11, 1930); enhanced lines of Fe, Ti, Sr, Sc and Yt are conspicuous 3 days after minimum light and strengthen relatively to the natural lines until phase 20 days, then diminish until phase 50, from then until phase 63 days; absorption lines are the most numerous, the Fe lines 4376, 4482 and 4489 being dominant; 3 days later the enhanced lines again dominate, and in this interval spectral variation is greatest. The G band is absent between phases of 5 and 25 days, and strong between 50 and light minimum. $H\delta$, $H\gamma$ and $H\beta$ are dark, but at certain phases have associated emission lines and are in good agreement with Cepheid behaviour. $H\alpha$ is bright in certain phases and may be present in all, though very weak. A. S. D. M.

4150. Spectrophotometric Study of η Aquilae. C. J. Krieger. *Astrophys. J.* 74. *pp.* 10–23, *July*, 1931.—The spectral type of this Cepheid is found to vary between F2 and G5, and the surface temperature varies from 4100° to 7000°. The intensities of three hydrogen lines, of H and K, and of the G band have been determined in terms of the intensity of the continuous background. **Erratum,** *ibid.*, p. 154, Sept., 1931. M. A. E.

4151. Peculiar Stellar Spectra. Part II. B.D. −18°3789. W. W. Morgan. *Astrophys. J.* 74. *pp.* 24–34, *July*, 1931.—Variations in relative intensities of groups of absorption lines, though common in the spectra of variable stars, are difficult to explain when occurring in stars which are steady in their light. In α^2 Canum Venaticorum there are two such groups, one of which was found to be due to the rare earth europium, and this group is sometimes almost invisible, sometimes one of the strongest in the spectrum. In 1928 four europium lines appeared in a spectrum of the star B.D. −18°3789. They, and also an unidentified line at λ4296, vary greatly in intensity in a period of $3^d\cdot18$. The chromium lines vary also, but are always opposite in phase to the first group, while lines due to other elements are constant. Possibly europium is connected with some state of physical change, and if more of these peculiar stars are discovered and studied, important results bearing on the basic laws of stellar evolution will doubtless be obtained. M. A. E.

4152. Four Aspects of the Mechanism of Stellar Radiation. C. Bialobrzeski. *Acad. Polonaise Sci. et Lettres, Bull.* 1*A*. *pp.* 1–15, *Jan.*, 1931. *In French.*—The author discusses (1) the presentment of radiation as a stream of energy traversing a star from its centre to the surface as a fall in temperature, the rays of various lengths moving in all directions, but always with an excess motion away from the centre; (2) the photons composing the radiation as distributed through the stellar material in a fashion resembling the Brownian movement. After a longer or shorter time each photon reaches the surface from the centre, and he gives (as an example) for the time (τ) as 55,313 years for the bright component of Capella, and 632,571 years for the Sun. For $\bar{\tau}$, the mean time, he finds $\bar{\tau} = E(L)^{-1} = 3\alpha GM^2(2RL)^{-1}$, where L is the total energy and R the star's radius. He points out that it is necessary to admit the existence of independent sources to maintain this action throughout stellar time; (3) he mentions the question of the disappearance of both matter and radiation from the star whilst retaining these ultimate sources; (4) he shows that at each moment there must be regions in the radiating star, where, for a time, more energy is emitted than absorbed, or *vice versa* (foci of emission and absorption), and this part of energy escapes into surrounding space, and he connects this with fluctuations in thermodynamic equilibrium; (5) he supports Eddington in his recent controversy with Milne, since $\bar{\tau}$ is very low as compared with any time occupied in the passage of a photon through any layer (of variable opaqueness) near the star's surface.

A. S. D. M.

4153. Atomic Synthesis and Stellar Energy. R. d'E. Atkinson. *Astrophys. J.* 73. *pp.* 250–295, *May, and pp.* 309–347, *June,* 1931.—A synthesis theory of stellar energy and of the origin of the chemical elements is developed, in which the various elements are built up from lighter ones, in stellar interiors, by the successive incorporation of protons and electrons one at a time. Helium cannot well be formed thus, and is assumed to be produced entirely indirectly, by the disintegration of unstable nuclei which have first been formed. The probability that a proton will penetrate a nucleus is obtained from wave mechanics, in the case of the lighter elements; it appears that only very small amounts of these would be present if the temperatures were very high. A second synthesis process for protons has therefore to be assumed; it possesses arbitrary but very simple properties. The elements whose disintegration supplies helium are in all cases those known (or strongly suspected) to be unstable, or those isotopes whose instability would follow from Gamow's theory of mass defects. With the aid of the chemical law of mass action, the requirement that the radiation of any one star must be nearly constant, and an analogue of the radioactive equilibrium law, the following conclusions are obtained: The sun's central temperature is about 16 million degrees, and the main sequence consists of stars whose central temperatures rise a little with the mass; this is in good agreement with observation if stars are polytropes of constitution about half hydrogen, and with a polytropic index rising slightly with the mass, as in Jeans' modification of Eddington's theory. The relative proportions of the elements are calculated; all the main features of Russell's curve for the sun's atmosphere are obtained without special assumptions. In the low-density giants the source of helium is different from that in the main sequence; this also explains the Hertzsprung gap. The brightest red supergiants, in spite of their low density, require central temperatures of only 4 million degrees. Stars in general will probably be stable, but very diffuse giants should all pulsate. The presence of R and N types among giants, and their absence among dwarfs, the occurrence of coeval pairs in which the brighter is the cooler, the fact that the brightest stars in a cluster are usually all red or all blue and the absence of very diffuse stars of small mass, are all in harmony with the theory. White dwarfs occur when hydrogen has become scarce; synthesis and electrostatic forces both remove it from the centre, and very high temperatures will no longer develop too much energy. AUTHOR.

4154. Model Stellar Atmospheres. W. H. McCrea. *Roy. Astron. Soc., M.N.* 91. *pp.* 836–857, *June*, 1931.—An attempt is made to deduce the behaviour of stellar atmospheres from purely physical data. It is only possible to calculate the behaviour of simple models. The model dealt with consists of a mixture of hydrogen and an arbitrary hydrogen-like element X. The absorption coefficients and degrees of ionisation of these two elements are calculated. The equilibrium conditions and general behaviour of the model atmosphere are then calculated for various abundance ratios of H and X and for various temperatures and gravitational forces. Considerable agreement is found between the properties of the model atmosphere and the observed properties of stellar atmospheres. The special case of hydrogen atmospheres is then discussed, especially with reference to the absorption at the head of the Balmer series and to the structure of the spectral energy curves. The importance of hydrogen as a constituent of stellar atmospheres is stressed. J. E. K.

4155. Statistical Study of Stellar Temperatures. H. Kienle. *Zeits. f. Astrophysik*, 3. 1. *pp.* 1–25, *June* 29, 1931.—The study of catalogues of colour indices of stars leads to the conclusion that a star must be characterised by at least two parameters, absolute luminosity and effective temperature, and that the existence of " preferential temperatures " for stars is an illusion. The stars can be divided according to their temperatures into two classes only, the main series and the giant branch. It is also not sufficient to describe a star cluster by means of a " typical colour-index " alone. There must be at least one further parameter giving the connection between the distribution of colour indices and the luminosities. G. C. McV.

4156. Maximum Mass of Ideal White Dwarfs. S. Chandrasekhar. *Astrophys. J.* 74. *pp.* 81–82, *July*, 1931.—The theory of the polytropic gas spheres in conjunction with the equation of state of a relativistically degenerate electron-gas leads to a unique value for the mass of a star built on this model. This mass ($= 0 \cdot 91 \odot$) is interpreted as representing the upper limit to the mass of an ideal white dwarf. [See also Abstract 2207 (1931).] AUTHOR.

4157. De Sitter's Universe and the Motion of Nebulæ. G. Castelnuovo. *Roy. Astron. Soc., M.N.* 91. *pp.* 829–836, *June*, 1931.—The author shows that the modification of the Doppler effect due to the curvature of space is insufficient to explain the apparent motion of the extra-galactic nebulæ, if their real motions are assumed to be distributed at random (" disorganised movement "). A quantitative explanation of the observed facts is obtained by assuming a real organised motion, such as would occur if an immense primitive nebula were scattered at an enormously distant time (*i.e.*, at time $-\infty$) so as to give rise to the present system of nebulæ moving freely through curved space. On this hypothesis the radius of curvature of space is found to be 2×10^9 light years; in $1 \cdot 4 \times 10^9$ years the distances between the spiral nebulæ would be doubled provided these distances do not exceed 10^8 light years. These values agree with those deduced on the hypothesis of the expanding universe of Friedman-Lemaître. J. S. G. T.

4158. Apparent Velocity-Shifts in Faint Nebulæ Spectra. M. L. Humason. *Mt. Wilson Observat. Contrib. No.* 426. *Astrophys. J.* 74. *pp.* 35–42, *July*, 1931.—A table is given of the apparent velocity-shifts and spectral types of 46 extra-galactic nebulæ photographed with the new Rayton spectrograph (one prism, 875 Å. per mm. at λ4500) on the 100-in. reflector. Twenty-four nebulæ are in 7 clusters, 4 in a group in Pisces and 18 are isolated nebulæ. Both clusters and isolated nebulæ are photographed; for the cluster nebula gives the greatest possible distance for a given apparent luminosity and the several brightest members may be taken to represent the cluster as a whole in line-displacement, and isolated nebulæ test the possibility of a systematic difference between them and clusters. Four lines are generally recognisable: H and K, Hδ and the G band at λ4303·14; occasionally Hγ(λ4340), λ4383(Fe), and Hβ(λ4861) can also be identified. The largest displacement attained is 19,600 km./sec. for a 16·8 (photo) magnitude cluster in Leo. The range of velocities in any single cluster is small except in Coma, where N.G.C. 4865 stands out from the rest in this respect alone. The author describes the measurements and determinations of spectral types, using I.A.V. criteria for bright-line nebulæ and comparing the others with M. 32. A widening of lines is seen in the fainter nebulæ (as in high dispersion spectra of M. 31 and 32). Continuous spectrum maximum is shifted by velocity-displacement, suggesting colour excess but seemingly dependent on galactic latitude rather than distance. [See also following Abstract.] A. S. D. M.

4159. Velocity-Distance Relation among Extra-Galactic Nebulæ. E. Hubble and M. L. Humason. *Mt. Wilson Observat. Contrib. No.* 427. *Astrophys. J.* 74. *pp.* 43–80, *July*, 1931.—The authors discuss methods [see preceding Abstract] for determining such distances, and obtain a revised value (– 14·7) for the visual mean absolute magnitude; they find evidence for a fairly uniform upper limit to stellar luminosity in the great isolated systems, thus affording a criterion of distances in cases where types can be identified. A table is given of apparent magnitudes of nebulæ and of their brightest stars, indicating that the scattering in the observed $m_s - m_n$ is fully accounted for by that in M_n, and that in clusters at various distances the scattering in M_n is shown by the scattering in m_n in each cluster. The distance of a nebula given by the brightest stars involved is $\log D = 0 \cdot 2 m_s + 2 \cdot 2$, where D is in parsecs. It is found that $m_s - m_n$ varies systematically with the type. The total apparent magnitude of nebulæ is a more trustworthy criterion of distance than their diameter. The range in absolute luminosity of nebulæ is about five magnitudes. The authors advise the using of extra-focal images larger than the focal dimensions of the nebulæ in their photographic photometry. The colour-indices of 60 Virgo cluster nebulæ suggest a colour excess of the order of 0·3 magnitude, which has no conspicuous dependence on distance but whose largest value is in the lowest galactic latitude. A table is given of 40 new velocities (14 of which are isolated nebulæ) ranging from 890 to 19,600 km./sec.; that is, to 32 million parsecs. The effect of the red shift is 0·25 for the Leo cluster, 0·15 for the Ursa Major and 0·10 for the Coma. The velocity-distance relation is $v = d(1790)^{-1} = 558$ km./sec. per million parsecs. For the masses of nebulæ, the most direct indication is given by spectrographic rotations. A. S. D. M.

LIGHT.

4160. Influence of Glass-Forming Earths on the Turbidity of Silicate Glasses Produced by the Addition of Fluorides. G. Gehlhoff, H. Kalsing and M. Thomas. *Zeits. f. techn. Physik*, 12. 7. *pp.* 323–344, 1931.—Measurements of transparency, reflection and absorption, and of the number and size of the scattering particles, are made for turbid glasses of definite composition containing fluorides. The transparency decreases in the order Mg, Ca, Sr, Ba, Zn, Pb. The turbidity increases as the proportion of fluoride increases, and as that of sodium decreases. Lead glasses show low absorption with high turbidity. Small quantities of alumina decrease the turbidity, but the glass becomes denser with higher proportions. Turbidity is reduced in proportion to the borate content. The more transparent a glass is, the more easily it can be made turbid. The form in which the fluorine is added is immaterial provided that the composition is the same, although some forms lend themselves better to commercial processes. The size and number of scattering particles appear to be in approximately hyperbolic relationship with the transparency. C. B. A.

4161. Absorption of Light by Sodium Flames. C. D. Child. *Phys. Rev.* 38. *pp.* 699–708, *Aug.* 15, 1931.—The intensity of the light from flames containing sodium vapour was found to equal approximately $e/a_0\{(1 + 2a_0x)^{1/2} - 1\}$, where x is the number of flames, e the amount of light that would be emitted per unit thickness, if no light were being absorbed, and a_0 is the coefficient of absorption for the sodium light at the beginning of its passage through the vapour. This expression is based on the assumption that the coefficient of absorption becomes less the further the light passes through the vapour. This may be expressed by the formula $a = a_0/(1 + 2a_0x)$, where a is the coefficient for light that has passed through x flames and a_0 is the value given above. The values found for e and a_0 were 2·06 and 4·33 respectively, where one flame into which a 0·1 % solution of NaCl was being sprayed was taken as the unit of intensity of light. The light from flames into which different concentrations of NaCl were sprayed varied less rapidly than the square root of the number of flames. This is explained by assuming that with greater concentrations the molecules of salt in the flame are less completely dissociated, and that this is due to a constant dissociation and recombination of the sodium and chlorine atoms in the flame. AUTHOR.

4162. Complex Indicatrix of Antimony Sulphide. A. Cissarz. *Zeits. f. Krist.* 79. *pp.* 445–461, *July*, 1931.—Using a Berek microphotometer, an investigation was made of the three principal reflection powers of polished slices cut from crystals of antimony sulphide. Measurements were also made of the bi-reflection for green, orange and red filters. From the results of these measurements the three principal sections of the complex indicatrix of antimony sulphide were determined. The curve of the principal section R_α/R_γ shows a definite hump and two dents. In both the other principal sections the curves show no such irregularities. The results are discussed in their connection with others obtained with rhombic absorbing crystals of mean refractive index. A. W.

4163. Measurement of Feebly-Luminous Ellipticities. J. P. Mathieu. *J. de Physique et le Radium*, 2. *pp.* 189–197, *June*, 1931.—An arrangement is proposed for the analysis of a luminous vibration of very slight ellipticity. This is formed by the combination of an ordinary rectilinear analyser with penumbra and of an auxiliary doubly-refracting plate which plays a part which differs from that of the compensating plate in the classical methods of analysis due to Chauvin and to Brace. This auxiliary plate changes only the direction of the course of the vibration studied. This result is obtained by causing the plate to turn in its plane through an angle which is in relation with its own retardation and with the value of the ellipticity to be measured. The thickness to be given to the compensating plate is considered and also its standardisation and the choice of the rectilinear analyser to be employed. J. J. S.

4164. Possibility of Demonstration of Rotation-Isomers. K. L. Wolf and W. Bodenheimer. *Zeits. f. phys. Chem. Bodenstein-Festband*, *pp.* 620–626, 1931.—The possibility of the demonstration or isolation of the isomers arising from free-rotation in optically-active molecules is discussed from the points of view of dipole-moments and of the variation of rotatory power with temperature and concentration. A number of ways in which the existence of the isomers might be demonstrated is suggested. C. B. A.

4165. Photodichroism and Photoanisotropy. Part VIII. Induced Photodichroism by Excitation with Mixed Light. F. Weigert and F. Stiebel. *Zeits. f. phys. Chem.* 13. *Abt. B.* 4–5. *pp.* 285–298, *Aug.*, 1931.—The anomalous additive photodichroitic effect described in the previous paper [see Abstract 98 (1931)] is here further studied. It is now found that especially strong anomalous effects are obtained when one of the components of the mixed light is red. The phenomenon becomes more explicable when experiments are carried out with a mixture of polarised and unpolarised light. The results of this arrangement throw light on the nature of the developable latent image and in general on photographic processes. J. E.

4166. Decomposition of the Absorption Bands of Xenotime by a Transverse Magnetic Field. New Interpretation of the Magneto-Electric Effect. J. Becquerel and L. Matout. *Comptes Rendus*, 193. *pp.* 158–161, *July* 20, 1931.—Further consideration of the "magneto-electric effect" [see Abstract 3036 (1931)] shows that the internal electric field reproduces the symmetry of the crystal lattice. Two completely distinct types of absorption band are observed, one being independent of the orientation of the binary axes, the other obeying the following simple law: Starting from a given orientation of binary axes and incident vibration, after turning the axes through any angle, the original effect can be reobtained by turning the incident vibration through twice that angle in the same sense. The original explanation of the effect on the basis of separation by the magnetic field of the circularly polarised components produced by the internal electric field is not satisfactory, and it is concluded that the components are in reality fixed and plane-polarised. Certain bands would then behave as in the Zeeman effect, while the others would have their components polarised in two perpendicular directions, which would turn through twice the angle when the binary axes are rotated. It is in this latter case only that the internal electric field becomes effective. The new interpretation should explain all the facts, and further experiments are in progress in order to test it. C. B. A.

4167. Invariant of Magnetic Rotation for some Fused Organic Substances. C. Salceanu. *Comptes Rendus,* 193. *pp.* 161–162, *July* 20, 1931.—The de Malleman expression $\frac{\Lambda n d}{(n^2 - 1)^2}$ for the invariant of magnetic rotation, where Λ = Verdet's constant, and n and d are refractive index and density respectively [see Abstract 658 (1927)], is measured at various temperatures for fused β-methylnaphthalene, triphenylmethane, and phenanthrene, and is found to increase slowly with rise of temperature. Variations in the very marked magnetic dispersions observed in these compounds are attributed to the effect of temperature on the positions of the absorption bands. C. B. A.

4168. Application of the Fundamental Laws of Geometrical Optics to other Physical Variation Problems. M. Herzberger. *Phys. Zeits.* 32. *pp.* 551–553, *July* 15, 1931. *Paper read before the Deut. Phys. Gesell., Jena, May–June,* 1931.—The general optical law previously deduced [see Abstract 815 (1931)] is now applied to the deduction of further laws. C. B. A.

4169. Hartmann Test for Parabolic and Hyperbolic Mirrors. R. A. Sampson. *Roy. Astron. Soc., M.N.* 91. *pp.* 862–864, *June,* 1931.—Describes an improvement in the application of a method described by Hindle [see Abstract 2664 (1931)] to the Hartmann test for parabolic and hyperbolic mirrors. J. E. K.

4170. Improved Method for Reducing Fabry-Perot Observations. S. Tolansky. *Journ. Sci. Instruments,* 8. *pp.* 223–225, *July,* 1931.—A simple method for the reduction of Fabry-Perot observations on hyperfine structure measurements is described. Increased accuracy is obtained, less labour being involved than in the usual methods. AUTHOR.

4171. Accuracy of Detailed Survey with the Bosshardt-Zeiss Double-Image Tachymeter. K. Ulbrich. *Zeits. f. Instrumentenk.,* 51. *pp.* 361–369, *July,* 1931.—The results are given of an investigation into the accuracy of nearly 10,000 observations made in a detailed survey of nine communes in Vienna, in which twenty different instruments were used. For a mean distance of 130 m. the error of individual points is ± 3·6 cms., a result in good agreement with a theoretical investigation. R. S. R.

4172. Interferometer Level without an Air Bubble. C. Fabry. *Comptes Rendus,* 193. *pp.* 99–102, *July* 15, 1931.—The bottom of a glass cylindrical vessel is a convex or concave spherical surface of large radius of curvature and oil covers it to a depth of about 1 mm. The surface is illuminated normally from above by monochromatic light and the fringes observed after reflection from a semi-transparent plate. As the orientation of the surface alters, the centre of the spherical fringes will be displaced and a change of level of 0″·04 can be determined. R. S. R.

4173. New Source of Blue and Ultra-Violet Light. W. M. Cohn. *Phys. Zeits.* 32. *pp.* 559–561, *July* 15, 1931.—When thorium is bombarded with kathode rays in a vacuum of 0·5 to 5 × 10^{-3} mm. Hg, a blue light is emitted. Spectrograms show that the radiation is practically continuous from 6000 Å. to 2200 Å., with a maximum at about 4500 Å. The lamp is in the form of an X-ray tube of which the antikathode is coated with thorium and which is provided with a quartz window. A current of 1 mA at 25 kV suffices to excite the radiation, and the lamp is recommended as an alternative to the hydrogen tube for absorption and similar work. F. S.

4174. Daylight Factor Integrator. H. C. H. Townend. *Journ. Sci. Instruments*, 8. *pp.* 177–183, *June*, 1931.—This instrument determines mechanically the illumination at a point on a horizontal surface due to the direct light from the sky visible at that point. The instrument is set up at the point, and a telescope incorporated in it is made to traverse the boundary of the visible sky. The illumination (daylight factor) is read off from a small integrating wheel. AUTHOR.

4175. Photometer Eyepiece Employing Maxwellian View. J. S. Preston. *Journ. Sci. Instruments*, 8. *pp.* 189–193, *June*, 1931.—This paper deals with the design and use of a small photometer employing Maxwellian view and capable of being adapted for various purposes. In the first place its development was due to the need for a brightness photometer with a small field of view suitable for polar measurements on diffusing media. By the use of interchangeable lenses and eye-rings, however, its usefulness was widened, and several other applications are mentioned. The theory of the photometer is discussed, and a relation giving the appropriate brightness ranges under different conditions is deduced. The photometer head here described is identical with that used by the author in the determination of the reflection factor of magnesium oxide [see Abstract 2790 (1930)], in which case its compactness, together with the fact that it can be used on the usual type of photometer bench, led to its adoption. AUTHOR.

4176. Universal Colour Measuring Apparatus. K. Fischer. *Zeits. f. Instrumentenk.*, 51. *pp.* 347–360, *July*, 1931.—Particulars are given of a spectrophotometer which is more convenient to use than earlier types on account of the many changes in direction of the light path. The use of the instrument is described for the determination of a colour, including its black and white content, for spectrum analysis and colorimetry, for photography of the visible spectrum as in the analysis of emission and absorption spectra, its use as a photometer in measuring the darkening of photographic plates, films or papers, and in the study of the colour sensitivity of plates and the measurement of colour filters. R. S. R.

4177. Measurement of Brightness of Radioactive Luminous Compounds. H. F. Meacock and G. E. V. Lambert. *Journ. Sci. Instruments*, 8. *pp.* 214–220, *July*, 1931.—In this paper instruments are described for the measurement of luminous compounds of brightness of the order of 0·02 candle per sq. ft. One instrument is used for surfaces larger than about 6 mm. diameter, and the other, embodying the Maxwellian view, is designed for measuring smaller surfaces than this. In both instruments opal glass, illuminated through a green colour screen by a standard lamp running along a photometer bench, is used as the comparison surface. One instrument has a Lummer-Brodhun "brightness" type cube, and the compound is viewed through the central aperture. It is thus compared with the opal surface, which is seen by reflection in the interface of the prisms. In the other the compound is placed behind a small aperture. A lens forms an image of this aperture at the eye of the observer, who thus sees the lens as a surface of uniform brightness. This is viewed through a rectangular hole in a piece of silvered mirror set at 45° with the axis, and is compared with the opal surface which is seen by reflection in the surrounding portions of the mirror. The instruments are calibrated by an absolute method over a range of brightness from 0·002 to 0·03 candle per sq. ft., using rotating sectors to vary the brightness. Over this range the reproducibility obtainable is about 2 % for one instrument and within 10 % for that employing the Maxwellian view. AUTHORS.

4178. Latent Image in Physical Development. Part I. H. Arens. *Zeits. f. wiss. Phot.* **30.** 1–2. *pp.* **49–64,** *May,* **1931.**—In a normally exposed layer the photolytic silver is of negligible quantity compared with the nuclear silver (Weigert's *Ursilber*) and with that remaining (as complex silver thiosulphates) after fixation and prolonged washing; its direct estimation is therefore impracticable. Its relative amount may be increased by use of a fine-grained emulsion [see Abstract **2159** (**1929**)] or by physical development after fixation. The author combines both methods by the use of unripened chloride and bromide emulsions and physical development, estimating the total silver present after fixation and washing and both before and after development, and is able to determine the quantity of photolytic silver over part of the range of the normal characteristic curve. From grain-counts, the upper limit of the average mass of the silver particles at various exposure levels is estimated. Up to the foot of the (physical development) characteristic curve, the silver present is entirely nuclear, giving rise only to a steady level of chemical fog, and is relatively coarse. As exposure increases and photolytic silver is formed, the mean mass-limit of the particles falls to a minimum in the lower part of the curve and thereafter rises again, the latter change occurring at a point where the quantity of photolytic silver becomes of the same order as that of the nuclear silver, etc. Hitherto, increased developability accompanying the formation of photolytic silver depends upon the *number* of particles formed and not upon their size; the lowest value of the limiting particle mass is of the order 10^{-17} gm., corresponding to 10^5 silver atoms. The phenomena of solarisation require that in this region the size of the particles should continue to increase but their number to diminish. L. V. C.

4179. Photographic Copying Technique by Means of the Decolouring of Yellow Colloids by Light. E. Stenger. *Zeits. f. wiss. Phot.* 30. *pp.* 108–112, *Aug.*, 1931.—Makes use of the discovery of Poitevin that certain colloids become insoluble under the action of light. If gelatin is coloured by iron chloride or an oxysalt of iron (or chromium), light reduces the iron salt and renders the affected part uncoloured and soluble in hot water. Various methods of producing and copying coloured pictures based on this idea are given. The paper should be consulted for details. J. E.

4180. New Antifogging Agents in Developers. Part II. A. P. H. Trivelli and E. C. Jensen. *Frank. Inst., J.* 212. *pp.* 155–169, *Aug.*, 1931. *Phot. Indust.* 29. *pp.* 1162–1166, *Oct.* 28, 1931.—Among a series of amino-acids and other organic compounds, only cysteine hydrochloride and thiobarbituric acid showed antifogging properties in the developer, and the antifogging action is less than that of 6-nitrobenziminazole [see Abstract **447** (1931)] and produces more density depression. A preliminary microscopical investigation of the action of antifogging agents such as potassium bromide, potassium iodide, thioacetanilide and the three substances previously mentioned above has also been described; illustrative figures are included. H. H. Ho.

4181. Retarded Luminescence of Carbon Dioxide. Marie Kaczynska. *Acad. Polonaise Sci. et Lettres, Bull.* 1 *A. pp.* 16–19, *Jan.*, 1931. *In French.*—CO_2 formed by heating $MgCO_3$ in one part of the apparatus passes into a discharge tube, where it is excited by the discharge and then into another tube. The gas in the last tube is seen to exhibit a bluish fluorescence, which falls off in intensity as the distance from the discharge tube increases. When the discharge is stopped, the fluorescence in the discharge stops immediately, while that in the next tube persists showing that this is a delayed effect. This delayed luminescence has an intensity and a duration depending on the discharge current and on the pressure of the gas. It has been observed at a distance of 40 cm. from the line of discharge, and at a time delay of 8 sec. Its spectrum is different from that of the discharge luminescence. J. E.

4182. Fluorescence Radiation in Manganese Vapour. J. Fridrichson. *Acad. Polonaise Sci. et Lettres, Bull.* 2 *A. pp.* 69–75, *Feb.*, 1931. *In German.*—The fluorescence was investigated in saturated manganese vapour from 700°–800° C. Excitation with a manganese spark evoked the two resonance triplets of manganese. The relative intensities of the two triplets varied with the vapour-tension. The longer-wave triplet was also excited by white light, and by other discontinuous sparks. This is explained quantum-mechanically by the presence of the air line 4036 Å. in the spectra of the exciting sparks causing resonance. A. C. M.

4183. Fluorescence of Water Vapour. F. Rasetti. *N. Cimento*, 8. *pp.* 191–193, *May*, 1931.—Water vapour at atmospheric pressure illuminated by the ray λ2537 of Hg emits an intense fluorescent light in the ultra-violet. This fluorescent spectrum is continuous, has a very bright maximum around the exciting ray, and extends for some thousandths of 1 cm. towards the visible part of the spectrum. Experiments carried out with suitable precautions seem to exclude the hypothesis that the phenomenon may be due to the presence of mercury vapour. The intensity observed is some thousands of times greater than in the Raman diffusion. J. J. S.

4184. Radiation Accompanying the Hydration of Quinine Sulphate. M. Curie and M. Prost. *Comptes Rendus*, 192. *pp.* 1729–1730, *June* 29, 1931.—Quinine sulphate was placed on an electrode in an ionisation chamber which was evacuated, but could be connected with a source of very low pressure of water vapour. The electrode supporting the quinine sulphate was 1 mm. below another grid electrode connected to an electrometer, while another electrode 2 mm. above the grid was connected to 200 volts. It was estimated that the path of the radiation was equivalent to 10^{-7} cm. in air at atmospheric pressure. The number of ions compared with the number of molecules hydrated is exceedingly small. J. E.

4185. Galvano-Luminescence. R. R. Sullivan and R. T. Dufford. *J.O.S.A.* 21. *pp.* 513–523, *Aug.*, 1931.—A continuation of earlier work [see Abstract 1857 (1929)]. Galvano-luminescence is the term applied to the luminescence at the anode in solutions. Water-cooling of the anode results in increased efficiency and brightness. Spectroscopic evidence indicates that the scintillations have a gaseous origin and the steady glow another origin. It is shown that under certain conditions the brightness increases with the applied voltage in the same way as the brightness of an incandescent filament. Systematic differences were found in the behaviour of different groups of metals in nine different Grignard reagents. A solution of $MgBr_2 2(C_2H_5)_2O$ gave a glow at unusually low voltages, and gave the highest efficiency yet found. J. E.

4186. Absorption Spectrum of Rubidium Vapour. S. Datta and H. S. Maitra. *Zeits. f. Physik,* 70. 7–8. *pp.* 548–551, *July* 14, 1931.—An investigation of this spectrum is described, and a table of the principal series is given with a photograph of the lines. The lines of the chief series were observed up to $m = 38$ as absorption lines, and their wave-lengths measured. The series equation shows satisfactory agreement between observed and calculated values with the exception of deviations occurring in the last pair of lines for which a possible explanation is given. The first nine series members were analysed into their components. Six only were formerly observed. The combination lines $1s - 2d$ and $1s - 3d$ were distinguished as absorbed, a significant example of contradiction of the selection principle. J. J. S.

4187. Ultra-Violet Absorption of Benzene Derivatives and the Theory of Induced Alternating Polarities. K. L. Wolf and W. Herold. *Zeits. f. phys. Chem.* 13. *Abt. B.* 3. *pp.* 201–231, *July,* 1931.—Errors in dipole measurements of disubstitution derivatives of benzene have withheld valuable criteria for judging the theory of induced alternating polarities, and the present paper seeks a solution by the measurement of the absorption spectra. Six comprehensive tables of results are included which appear to support the theory. H. H. Ho.

4188. Absorption Line Width in Sodium Vapour. S. A. Korff. *Phys. Rev.* 38. *pp.* 477–486, *Aug.* 1, 1931.—Spectrograms of the D lines of sodium in absorption were obtained and measured on a densitometer, thus determining an optical constant which was uncertain in former work. Absolute contours in terms of transmitted intensity against wave-length were obtained. Possible sources of error were studied in detail. The observed contours were compared with the classical formula. The contours were found to have the theoretical inverse square variation of opacity with wave-length distance from resonance; they showed the theoretical variation of width with the square root of the number of atoms in the line of sight, and the 2 : 1 ratio between the two D lines. The width of the lines was, however, about five times that for which classical radiation damping accounts. A detailed further experimental study of this discrepancy is planned. AUTHOR.

4189. Infra-Red Spectrum of SnI. H. M. Randall and N. Wright. *Phys. Rev.* 38. *pp.* 457–462, *Aug.* 1, 1931.—An open arc of 80 amperes between a carbon rod and tin pool has been used as source, and observations have been made using a grating spectrometer and thermopile. The wave-lengths of 45 new lines of the tin arc spectrum in the region from 1μ to 3μ have been measured, and rough determinations of the relative intensities of the strong lines have been made. Nine energy levels of the $5s^2 5p6p$ configuration have been found, which with the one found by Green and Loring complete the set. Three of the four levels of the $5s^2 5p(^2P_{1/2})4f$ set have been found, and the fourth, 3_3, has been accounted for as lying too close to 4_2 for resolution. With the fixing of these levels all the strong infra-red lines have been classified. The finding of the levels $5p(^2P_{1/2})4f4_2$ and $5p(^2P_{1/2})5f4_2$ has made possible a good determination of the absolute term values. AUTHORS.

4190. Polymers and New Infra-Red Absorption Bands of Water. J. W. Ellis. *Phys. Rev.* 38. *pp.* 693–698, *Aug.* 15, 1931.—New absorption bands of water at 1·79 and 1·74μ are interpreted as combination bands arising from 510 cm.$^{-1}$ (19·5μ) + 1640(6·1μ) + 3450(2·90μ) and 510 + 1640 + 3580(2·79μ) respectively. The 19·5μ band, although somewhat hypothetical, is assumed to represent the vibration of one H_2O group against another, either in a simple polymer or in a definitely arranged lattice of H_2O groups. The well-known 4·7μ band, which has no parallel in the water vapour spectrum, probably is (510 + 1640)cm.$^{-1}$. The spectrum of selenite, $CaSO_4 . 2H_2O$, has bands paralleling all of the liquid water bands in the shorter wave region, but all resolved into doublets. AUTHOR.

4191. Spectrum of the Flame of Carbon Disulphide. A. Fowler and W. M. Vaidya. *Roy. Soc., Proc.* 132. *pp.* 310–330, *July* 2, 1931.—Investigation of the spectrum of the flame of CS_2 was undertaken with the object of throwing further light on the process of combustion of this substance. The observations made give information concerning some of the reactions which precede the formation of the well-known products of combustion, while not giving complete answers to all the questions arising. The most characteristic bands of the ordinary CS_2 flame, extending from the blue to the near ultra-violet, must be attributed to S_2, forming as they do part of the system already known to be due to S_2 molecules. The ultra-violet bands of S_2 appeared in absorption, but were obtained in emission when a stream of O was directed on the flame. Emission bands of SO also appeared feebly in the flame spectrum, and when the flame was enclosed in a chimney absorption bands of SO_2. The spectrum of the phosphorescent flame of CS_2, as photographed by Emeléus, was re-examined, and besides the characteristic flame bands forming Emeléus' first group it was found that the second group includes bands of SO and CS, the SO bands being relatively much stronger than in the normal flame. A group of bands in the ultra-violet have been provisionally attributed to carbonyl sulphide COS. A vibrational analysis of the flame bands is in general agreement with Rosen's scheme for S_2 as regards the ultra-violet bands, but differs from it considerably for the less refrangible bands. The amended scheme introduces an additional $v'v''$ progression, including the strongest flame bands and requiring that Rosen's v' values should be increased by unity throughout. Tables of bands and photographs of the spectra observed are given in the paper. J. J. S.

4192. Relationships between the Continuous and the Many-Lined Spectra of Hydrogen. Part III. Y. Hukumoto. *Tohoku Univ., Sci. Reports*, 20. *pp.* 433–459, *July*, 1931. *In English.*—The present paper contains the results of a spectroscopic examination of the negative glow and the Faraday dark space in hydrogen and some other related phenomena. The variation in intensity of spectra in the negative glow, the Faraday dark space and the positive column was followed accurately. The results obtained are fully described and exhibited graphically, and use is made of them to contribute to the view of Winans and Stueckelberg about the origin of the continuous spectrum of hydrogen. Some description is given about the spectra of H_2^+ ion. AUTHOR.

4193. Accurate Determination of Excitation Energy by Electron Impact in Helium. R. Whiddington and J. E. Roberts. *Leeds Philosoph. and Lit. Soc., Proc.* 2. *pp.* 201–205, *May*, 1931.—By an electron-gun arrangement electrons with about 120 volts velocity were fired across a field-free iron-clad space. He was present in this space at a pressure about 0·01 mm. Hg. The electrons traversed a retarding electric field and were caused to form a magnetic spectrum on an oiled photographic film. Excitation energies in He were thus measured with a degree of precision not hitherto attained. The following are the values obtained with their probable errors in volts, the values calculated from spectroscopic data being also given:—

Experimental.	Calculated.	Origin.
21·24 ± 0·03	21·12	$1^1S_0 - 2^1P_1$
23·19 ± 0·04	22·98	$1^1S_0 - 3^1P_1$
23·84 ± 0·10	23·63	$1^1S_0 - 4^1P_1$

The observed values are all a little greater than the calculated ones by an amount exceeding the probable error. J. J. S.

4194. Broadening of the Resonance Atomic Line of Helium. W. Weizel. *Phys. Rev.* 38. *pp.* 642–645, *Aug.* 15, 1931.—The asymmetric broadening of the resonance atomic line of helium is explained by the shape of the potential energy curves of the two centre systems consisting of two helium atoms. The broadened atomic lines account for some of the unstable electronic levels of the helium molecule (He_2), which have hitherto not been found. AUTHOR.

4195. Perturbations in the Helium Band Spectrum. G. H. Dieke. *Phys. Rev.* 38. *pp.* 646–657, *Aug.* 15, 1931.—The helium bands furnish an extensive material for a test of the theoretical conditions, which according to Kronig [see Abstract 3234 (1928)] must be fulfilled in order that a perturbation may occur. It was found that: (i) Whenever two energy levels come close together which satisfy those conditions, a perturbation occurs. (ii) For those perturbations which cannot be traced to the coincidence of two known terms it can be shown that there must be as yet empirically unknown levels with the required properties to produce these perturbations. (iii) Whenever two levels come close together which do not satisfy Kronig's conditions, no perturbation occurs. The nature of the observed perturbations is discussed. Only one term of each sequence is perceptibly perturbed, but at least in one case it can be clearly seen that all the levels after the perturbations are displaced by a constant amount with respect to those before the perturbation. It is also shown how the intensity anomalies may be explained. AUTHOR.

4196. Explosion Spectra of Metals. T. Tucholski. *Acad. Polonaise Sci. et Lettres. Bull.* 2*A. pp.* 76–105, *Feb.*, 1931. *In French.*—A spectrographic study of explosions made in the following ways: (1) picrates heated to the explosion temperature (" explosions "); (2) picrates detonated in a mixture of collodion and nitroglycerin (" detonations "); (3) picrates burned in collodion and in nitroglycerin. It is found that the spectra of the metals in these explosions are flame spectra, the structure of which depends upon the temperature. There is a complete absence of spark lines. The spectra obtained by detonation are also flame spectra, and indicate temperatures between the limits 1900° and 3200° C. Photometric observations with a photoelectric cell show that the intensities of the light in the case of explosions and detonations are of the same order. Mixtures of collodion with picrates when detonated emit a quantity of light proportional to the luminous surface of the gases liberated, for the same composition of the mixture, but different charges. The brightness increases as the concentration of the picrates increases. A. C. M.

4197. Vibration Analysis of Antimony Oxide. B. C. Mukherji. *Zeits. f. Physik,* 70. 7–8. *pp.* 552–558, *July* 14, 1931.—Measurements were made of the bands of the spectrum of SbO in the region between λ3300 and 6000. The bands were arranged in four systems, whose vibration constants have the following values per cm.:—

	ν_e	ω_e'	$\kappa'\omega_e'$	ω_e''	$\kappa''\omega_e''$
System A	29,749·4	586	6·5	824	5·9
System B	26,600·4	573	4·5	813	3·3
System C	24,317·4	586	6·5	813	3·3
System D	20,655·7	565	3·5	808	3·8

The dissociation heat calculated for the ground condition of the molecule amounts to about 3·5 volts. Photographs of the band systems and full tables of the observed values are given in the paper. J. J. S.

4198. Intensity Measurements in the Copper Arc. L. S. Ornstein and D. Vermeulen. *Zeits. f. Physik,* 70. 7–8. *pp.* 564–566, *July* 14, 1931.—A reply to the paper of Nottingham [see Abstract 3087 (1931)]. The authors have repeated Nottingham's experiments and find that with higher current strengths their curve agrees with his, but not with lower currents. The excitation potential is not dependent on the strength of current. Using a copper arc similar to that of Nottingham they found distinct evidence of self-absorption. The mechanism of the copper arc is completely similar to that of the carbon arc, and the temperature and ionisation of the gases in the arc play an essential part in the intensity transport. The authors consider that when carefully used the photographic method is a valuable one, and its results not less trustworthy than those of the thermoelectric or photoelectric methods. J. J. S.

4199. Low-Voltage Excitation of Sodium. W. C. Michels. *Phys. Rev.* 38. *pp.* 712–717, *Aug.* 15, 1931. In an attempt to clarify the available data on excitation of atoms by low-velocity electron impact, the author has studied the optical excitation function of the resonance lines in sodium vapour in the range from 1·8 to 4·2 volts. It is found that the excitation probability has three distinct maxima, corresponding to excitation to 3^2P, 4^2S and 5^2S states. Within 0·2 volt of the excitation potential the probability has dropped to xero and remains at that value until a new energy level is reached. No excitation to the 3^2D appears, possibly because of the existence of a selection principle in electronic excitation. AUTHOR.

4200. Broadening of Unmodified Lines in Light Scattering. M. J. Ney. *Acad. Polonaise Sci. et Lettres, Bull. 2A. pp.* 106–111, *Feb.*, 1931. *In French.*—Broadening of the unmodified lines is sometimes attributed to a Raman effect due to molecular rotation. If this explanation is correct, we could not expect broadening in the case of light scattering in solids. This is found to be confirmed by experiments with quartz at 18° C. and 500° C. There is no perceptible broadening in either case. It is concluded that the explanation of the broadening in liquids is true. A. C. M.

4201. Raman Spectrum of the Sulphate Ion. O. Specchia. *Accad. Lincei, Atti,* 13. *pp.* 754–759, *May* 17, 1931.—For concentrated sulphuric acid excitation by radiation of wave-length 4358·6 Å. causes the appearance of the characteristic SO_4 ion lines at 4438, 4468, 4568, and 4590 Å.; when the incident radiation is of wave-length 4046·8 Å. the lines appear at 4111, 4140, 4225, and 4244 Å. With increasing dilution of the acid the lines are displaced towards the longer wave-lengths, and simultaneously the line at 4535 Å. becomes weaker, and that at 4568 Å. becomes more intense. In solutions of lithium, magnesium, and manganese sulphates the characteristic lines of the SO_4 ion appear at 4443, 4475, 4556, and 4480 Å. H. F. G.

4202. Raman Spectra of Hydrogenated Derivatives of Naphthalene. G. B. Bonino and P. Cella. *Accad. Lincei, Atti,* 13. *pp.* 784–789, *May* 17, 1931.—The Raman spectra of tetrahydro- and decahydro-naphthalene are described and compared with those of naphthalene and cyclohexane. Decahydronaphthalene exhibits two lines, of frequencies 2922 and 2856 $cm.^{-1}$, characteristic of the carbon-hydrogen linking in the $:CH_2$ group, and one at 1448 $cm.^{-1}$ due to deformation oscillations of the $:CH_2$ group. Six other lines, which appear in the cyclohexane and naphthalene spectra, have been observed. Tetrahydronaphthalene presents a more complex spectrum, on account of the presence in the molecule of the aromatic ring; a line at 3049 $cm.^{-1}$ is characteristic of the aromatic carbon-hydrogen linking, and one at 1583 $cm.^{-1}$ of the aromatic linking $C{=}C$; in addition, all lines which are present in the naphthalene spectrum, and are due to the $:CH_2$ groups, are present. The spectra indicate that there is a difference between the deformation oscillations of the $:CH_2$ group in the adjacent (α) position to an aromatic $C{=}C$ linking, and those of the $:CH_2$ group in the β position. H. F. G.

4203. Raman Spectrum of Dichlorobromomethane. G. B. Bonino and L. Brüll. *Accad. Lincei, Atti,* 13. *pp.* 789–793, *May* 17, 1931.—The five principal lines of the Raman spectrum of dichlorobromomethane occupy positions which are intermediate between those of the corresponding lines of the chloroform and bromoform spectra; a sixth line which is present is attributed to a Cl-Br oscillation. The calculated value of the electric moment of the compound is $1{\cdot}25 \times 10^{-18}$. H. F. G.

4204. Raman Effect in Inorganic Complex Salts. G. Joos and I. Damaschun. *Phys. Zeits.* 32. *pp.* 553–554, *July* 15, 1931. *Paper read before the Deut. Phys. Gesell., Jena, May–June,* 1931.—The Raman effect was found of solutions of the following:—$Cu(NH_3)_4SO_4$, $Cu(NH_3)_4Cl_2$, $Zn(NH_3)_6SO_4$, $Cd(NH_3)_6Cl_2$, $Zn(NH_3)_6Cl_2$. In each case a line was found at about 24μ, due to the presence of the NH_3 groups. Amino-compounds of nickel and silver gave no such line. No lines due to hydrates were found. A. C. M.

4205. Circular Polarisation in the Raman Effect. W. Hanle. *Phys. Zeits.* 32. *pp.* 556–558, *July* 15, 1931.—Circularly polarised light is sent down a tube 1 m. long, and the light scattered back in the reverse direction is examined by deviating it to the side with a plane mirror, and its state of polarisation examined. Owing to the reversal of direction of translation of the light, a reversal of rotation would be expected. It is found that this occurs for some lines, but for others the reverse occurs. Chloroform, carbon tetrachloride, benzene, toluene and xylene have been examined. It is found that for the same shift, the state of polarisation is the same, whether Stokes or anti-Stokes. Strong lines are usually strongly polarised when linearly polarised light is scattered; when the original light is circularly polarised, these lines are also circularly polarised, and in the expected direction. Lines which are unpolarised, or only weakly depolarised when the original light is linearly polarised, show reversed direction of rotation when the original light is circularly polarised. The more symmetrical the scattering molecule the greater is the number of reversed circularly polarised lines, and the stronger does the degree of polarisation seem to be. Corresponding lines of different substances show the same type of circular polarisation. A. C. M.

4206. Influence of Exciting Frequency on Intensities of Lines in Raman Spectra. S. C. Sirkar. *Indian Journ. Phys.* 6. *pp.* 133–146, *July* 31, 1931.—The ratios of the intensities of the prominent Raman lines due to benzene and carbon tetrachloride to those of the incident exciting mercury lines in the visible and ultra-violet regions of the spectrum have been determined from blackening—log. intensity curves. It is found that the main conclusions arrived at by the author in the previous investigations are correct. The question about the proper method of taking into account the absorption of the scattered rays in the ultra-violet region in passing through the column of liquid in the Wood's tube, is discussed and verified experimentally. It is found that the author's method is quite correct, and that the assumptions which led Ornstein and Rekveld [see Abstract 1234 (1931)] to criticise the author's method are wrong. It is also shown that the above fact affects the results obtained by Rekveld [see Abstract 3096 (1931)] recently in the case of methyl alcohol. The results obtained by the author are discussed from the theoretical point of view, and it is shown that all the results obtained so far for different liquids are in agreement with the theory put forward by Placzek. AUTHOR.

4207. Raman Spectra of Glycol and some Organic Chlorine Compounds. V. N. Thatte and S. M. Shahane. *Indian Journ. Phys.* 6. *pp.* 155–163, *July* 31, 1931.—Results of the study of the Raman spectra in glycol, per-chlorethylene, chloral, tetra-chlorethane and penta-chlorethane are reported in this paper. The spectrum of glycol resembles that of glycerin, and likewise shows a continuous spectrum which is divided into two distinct portions. The strong shift $\Delta\nu$ 1570 in per-chlorethylene is due to the double bond $C = C$. The spectra of chloral and acetaldehyde are compared and the effect of substituting the hydrogen atoms by chlorine atoms on the scattered spectrum is discussed. A comparative study of the Raman spectra in the chlorine-substituted compounds of C_2H_6 is made, and it is shown that as the number of chlorine atoms increases the value of the corresponding shift also increases. AUTHORS.

4208. Hyperfine Structure of Heavy Elements. G. Breit. *Phys. Rev.* 38. *pp.* 463–472, *Aug.* 1, 1931.—The ordinary theory of hyperfine structure splitting is incomplete for two reasons in the case of heavy elements. (1) When the electron is close to the nucleus its velocity is high. Non-relativistic approximations to Dirac's equation become meaningless. (2) The probability of the electron being sufficiently close to the nucleus to interact with it at all may be appreciably different for different components of the same multiplet. General relativistic formulæ are derived for single electron spectra. Quantitative estimates are made for the specific case of the Tl lowest p term. The non-relativistic approximations with the same $\overline{r^{-3}}$ for $p_{1/2}$ and $p_{3/2}$ are found to give values of $(\Delta\nu)p_{1/2}/(\Delta\nu)p_{3/2}$ which are too small by a factor of about $3{\cdot}4 = 2 \times 1{\cdot}7$. The factor 2 is attributable to relativistic corrections. The estimated factor $1{\cdot}7$ is due to the higher energy of the $p_{3/2}$ level, which decreases the chance of the electron to be close enough to the nucleus to interact with it. Comparison with the observations of J. Wulff on TlI shows that even the corrected value of $(\Delta\nu)p_{1/2}/(\Delta\nu)p_{3/2}$ is too small by a factor of 2. A qualitatively similar disagreement exists for BiI. The observed hyperfine structure of these elements is therefore not accounted for by the theory of a nuclear magnetic moment. AUTHOR.

4209. Effect of Hyperfine Structure on the Polarisation of Cadmium Resonance Radiation. A. C. G. Mitchell. *Phys. Rev.* 38. *pp.* 473–476, *Aug.* 1, 1931.—The polarisation of cadmium resonance radiation (λ3261) has been calculated, assuming that cadmium is composed of two kinds of isotopes having a nuclear moment $i = 0$ and $i = 1/2$ respectively. The ratio of the isotopes of nuclear moment $i = 1/2$ to $i = 0$ was taken from the hyperfine structure data on cadmium as measured by Schüler and Keyston [see Abstract 2295 (1931)]. The percentage polarisation to be expected for " broad " and " narrow " line excitation and for different orientations of electric vector and magnetic field are given and comparison is made with Soleillet's experiments [see Abstract 3032 (1928)]. AUTHOR.

4210. Theory of Radiation. E. Fermi. *Annales de l'Inst. H. Poincaré,* 1.1. *pp.* 53–74, 1931.—The author develops a mathematical theory, involving Hamiltonian principles, which permits the discussion of undulatory or quantum radiation theory indifferently, and applies the theory to the brief discussion of the Compton and Doppler effects. J. S. G. T.

4211. Field Distribution and Sources of Error in the lo Surdo Method for the Stark Effect. W. Steubing. *Ann. d. Physik,* 10. 3. *pp.* 296–310, *July* 11, 1931.—Discusses constructively and experimentally the lo Surdo method, giving the conditions for the successful interpretation of the Stark effect obtained by it. J. E.

4212. Effects of Thermal Strain on Intensity of Reflection of X-Rays by Crystals. Y. Sakisaka and I. Sumoto. *Phys. Math. Soc. Japan, Proc.* 13. *pp.* 211–217, *July,* 1931. *In English.*—A preliminary study has been made of the effects of thermal strain on the intensity of reflection of X-rays transmitted through a crystal plate. The strain was produced in the plate by applying a temperature-gradient along a certain direction, and the change of intensity was examined by the Laue photographic and the spectrometric methods. It was found that, in the case of perfect crystals such as quartz, sodium chlorate and calcite, the contribution in reflection of X-rays from the interior of the crystal plate increased in a remarkable degree, while, in the case of an imperfect crystal, sulphur, the effects were very small. The phenomena have been interpreted as due to the change of extinctions by the strain. [See also Abstract 514 (1931).] Authors.

4213. Theory of X-Ray Interference in p-Azoxyanisole. E. Buchwald. *Ann. d. Physik*, 10. 5. *pp.* 558–578, *July* 29, 1931.—Previous work by Herrmann and co-workers [see Abstract 3742 (1930)] on the X-ray interference in the case of *p*-azoxyanisole is investigated, and it is shown that the assumption of a parallel arrangement of the elongated molecules to extended aggregates is indispensable, and that the maxima found of intermolecular interferences proceed from these aggregates. In the magnetic field all these aggregates are directed, and the maxima perpendicular to the North-South direction are given by a summation of Bessel functions of zero order, and indicate an interference interval of 5·3 Å. The aggregates are undirected in the absence of a magnetic field, and the maximum is not given by the Bragg formula, but by a modified Keesom expression from which an interference interval of 5·4 Å. is derived. Both values favour the Katz viewpoint rather than that of Stewart. H. H. Ho.

4214. Scattering of X-Rays by Neon and Argon and Helium. G. Herzog. *Zeits. f. Physik*, 70. 9–10. *pp.* 583–592, *July* 22, 1931.—The intensity distribution of the scattered radiation in helium, neon, and argon has been calculated, using Waller and Hartree's method [see Abstract 3345 (1929)]. The results are in good agreement with those determined experimentally. The region of the validity of the Compton approximation has been investigated, and it is found that it is only satisfactory for heavy gases. F. J. W.

4215. Numerical Calculations of Atomic Scattering Factors. R. W. James and G. W. Brindley. *Phil. Mag.* 12. *pp.* 81–112, *July*, 1931. *Zeits. f. Krist.* 79. *pp.* 470–476, *Aug.* 1, 1931. *In English*—A summary of the work on the methods of determining theoretically the atomic scattering factors is given, and from it empirical methods are developed which are accurate enough for determining parameters in the analysis of crystal structures. The first is based upon values of the atomic scattering factors of atoms at rest which are calculated for atoms for which the charge distributions have been determined by Hartree's method of self-consistent fields. Reliable values are obtained for elements of atomic number less than twenty-five. The second uses the Thomas-Fermi method of approximating to atomic charge distributions. The possibility of applying a temperature correction to the scattering factor is discussed. **Errata,** *Phil. Mag.* 12. p. 729, Sept., 1931. F. J. W.

4216. Temperature and Diffuse Scattering of X-Rays from Crystals. Y. H. Woo. *Phys. Rev.* 38. *pp.* 6–14, *July* 1, 1931.—On the assumption that only the coherent radiation interferes the expression

$$[\mathrm{N}\mathrm{I}e^4(1+\cos^2\theta)/2m^2\mathrm{R}^2c^4]\left[(1-e^{-\mathrm{B}})\mathrm{F}^2+(\mathrm{Z}-\mathrm{F}^2/\mathrm{Z})\left\{1+\frac{h(1-\cos\theta)}{mc\lambda}\right\}^{-3}\right]$$

where $B = 6h^2/\mu k\Theta \cdot \phi(x)/x \cdot (1 - \cos\theta)/\lambda^2$ (*i.e.*, twice the value proposed by Debye), N is the number of atoms per unit volume of the crystal, and the other symbols have their usual meaning, is deduced for the intensity of the diffuse scattering, the first term representing the coherent, the other term the incoherent scattering [see Abstract 3164 (1930)]. Agreement with previous experimental results for rock-salt is satisfactory, and points to the presence of zero point energy. Agreement as regards variation with temperature is fair, but the comparison indicates that owing to the presence of the incoherent term the data available are not a satisfactory test for the present theory. Results for sylvine are calculated. C. A. S.

4217. X-Ray Apparatus for Powder Analysis. G. Grime. *Journ. Sci. Instruments,* 8. *pp.* 197–199, *June,* 1931.—An X-ray spectrograph for powdered crystal analysis at room temperature, designed to remain in constant adjustment, is described. AUTHOR.

4218. A Movable Antikathode for Demountable X-Ray Tubes. J. Böhm. *Zeits. f. Physik,* 70. 9–10. *pp.* 603–604, *July* 22, 1931.—It is sometimes desirable to be able to adjust the distance from filament to antikathode in an X-ray tube while the tube is exhausted. The paper describes a device which enables this to be accomplished by means of an antikathode of variable length. The apparatus is convenient in that it allows adjustments of focal spot to be made for spectrographic purposes. W. V. M.

4219. Ionisation Chamber Method of Measuring Relative Intensities of X-Ray Spectrum Lines. S. K. Allison and V. J. Andrew. *Phys. Rev.* 38. *pp.* 441–453, *Aug.* 1, 1931.—A two-compartment ionisation chamber has been constructed with the following properties: (1) The fraction of the X-ray energy absorbed in the front compartment could be directly measured. (2) The volume of gas from which the ionic saturation current was drawn was sharply defined. (3) Photoelectrons produced in the chamber could not reach the walls before expending their ionising energy. (4) The direct beam entered and left the chamber through thin windows and encountered no other parts of the chamber. The relative ionisation currents produced in methyl iodide, methyl bromide, argon, sulphur dioxide and air by the α_1, β_1, γ_1 lines of the tungsten L series were measured and the ratios obtained, after correction for the fraction of the direct beam absorbed, were found not to vary more than 2·5 % in the first four gases. If the air values are corrected for loss through scattering, concordant results are obtained. Similar experiments have been made using the uranium L-series, where large corrections for loss through escape of fluorescent K-radiation must be made, including the case of krypton, where the K limit comes between the uranium $L\beta_1$ and $L\alpha_1$ lines. The results give strong support to the following hypothesis: The saturation current obtained from a given volume of any gas is proportional to the fraction of the X-ray beam transformed into β-rays within it, providing the β-rays come to the end of their ionising range within the volume. AUTHORS.

RADIOACTIVITY.

4220. Radioactive Constants as of 1930. Report of the International Radium-Standards Commission. *J. de Physique et le Radium,* 2. *pp.* 273–289, *Sept.,* 1931. *Erratum, ibid., p.* 311, *Oct.,* 1931. *Am. Chem. Soc. J.* 53. *pp.* 2437–2450, *July,* 1931. *Rev. Modern Physics,* 3. *pp.* 427–443, *July,* 1931. *Phil. Mag.* 12. *pp.* 609–632, *Sept.,* 1931. *Phys. Zeits.* 30. *pp.* 569–581, *Aug.,* 1931.—The report of the Commission gives recent determinations of (1) basic values, (2) units and (3) constants. For the three radioactive gases the use of the terms radon (Rn), thoron (Tn), and actinon (An) is recommended. Instead of the designation "isotopic weight" (*poids isotopique*) for the whole numbered atomic weights or the number of hydrogen nuclei, the name "proton number" is proposed. J. J. S.

4221. Periodicity of Atomic Nuclei. R. Swinne. *Wiss. Veröff. a. d. Siemens-Konzern,* 10. 4. *pp.* 137–147, 1931.—The author reviews work done by himself and others on empirical relations between radioactive isotopes, particularly between disintegration constant and atomic weight, and also the number of nuclear electrons, with special reference to the kind of disintegration involved in each case (α or β). Suggestions are made as to the reasons for the relative frequencies of occurrence of the different elements, and as to the possible existence of elements with higher atomic weights and numbers than uranium. It is expected that these will prove to have specially long lives. The probable structures of the electronic shells of such elements and the resulting chemical properties are considered. H. N. A.

4222. Artificial Disintegration without Capture of the Projectile. E. C. Pollard. *Leeds Philosoph. and Lit. Soc., Proc.* 2. *pp.* 206–216, *May,* 1931.—General energy and momentum conditions are considered for a process of disintegration without capture, and it is shown that the maximum-range proton occurs when both α-particle and nuclear remnant move away together. From a simple picture of the process, deduced from the views of Gamow and of Gurney and Condon, such disintegration appears possible in the case of boron, but much less likely for aluminium. J. J. S.

4223. Annihilation of Matter. J. Jeans. *Nature,* 128. *pp.* 103–110, *July* 18, 1931. *Supplement.*—This article gives the substance of lectures delivered before the Universities of Princeton, Yale and Harvard. In it the author gives a short account of his theory that annihilation of matter constitutes one of the fundamental processes of the universe, and is the source of the energy radiated by the stars. He brings forward the astronomical evidence for this hypothesis which is based not on the intensity of stellar radiation, but on its duration. The rate at which the various types of stars are radiating their mass away in the form of radiation is known, and it is suggested that the life history of a typical star is one of continual annihilation of its substance, the electrons and protons annihilating one another, and providing the energy for the star's radiation in so doing. The highly penetrating radiation known as cosmic rays is regarded as affording direct evidence of this process of annihilation. The author discusses the nature of the cosmic radiation and the experimental observations which give its absorption coefficient, and has calculated the absorption coefficients (per 1 m. of water) for the radiation produced by the synthesis of iron and by the annihilation of 1 and 4 protons respectively, with their accompanying electrons. This calculation is based on the Klein-Nishina formula. This is compared with the absorption coefficients of the two most penetrating constituents of cosmic radiation as analysed by Regener, and the agreement between the two is most significant and suggests strongly that the most penetrating constituent of the cosmic radiation may originate in the annihilation of an α-particle and its two neutralising electrons (the components of a helium atom), while the next softer constituent may be due to the annihilation of a proton and its one neutralising electron (the components of an H atom). J. J. S.

4224. Radioactivity of the Alkali Metals. G. Orbán. *Akad. Wiss. Wien, Ber.* 140. *2A*. 3–4. *pp.* 121–139, 1931.—By means of the Wilson fog chamber, with use of alcohol vapour, K, Rb and Cs were examined. The β-rays of K were still able to traverse a layer of Al 0·05 cm. thick. For K β-rays, with 0·05 cm. Al, the value of μ/ρ was found to be 18, and for Rb, with 0·0020 cm. Al, μ/ρ was 160. The range of the Rb β-paths is estimated to be 25 cm. of air. Evidence is also given for the existence of a β group with 10-cm. range which the author considers to be identical with the group described by Hoffmann, $\left(\frac{\mu}{\rho}\right)_{\mathrm{Al}} = 330$. With Cs activity was not found; α-rays did not appear with the salt examined, and with K and Rb also no weak γ-radiation (up to 200 X limits of hardness) was observable. The distribution of angle of the β-tracks from saturated layers of K_2SO_4 and KBr did not obey the cosine law. For the number of β-particles sent out per unit of surface and per second the following values were found, using β-saturated layers:

K_2SO_4	KBr	KI	Rb_2SO_4	RbI
0·6	0·7	0·5	1·6	1·0

From this result and with the help of the μ/ρ values found the half-value time of Rb and K was determined as being $J = \frac{\lambda}{2} \cdot \frac{K}{M} \cdot \frac{\rho}{\mu} \cdot 6{\cdot}07 \times 10^{23}$, where μ is the mean value of the absorption coefficient. This amounts for Rb to $1{\cdot}6 \times 10^{11}$ years, and for K to 5×10^{12} years. The corresponding decay constants were $\lambda_{\mathrm{Rb}} = 1{\cdot}4 \times 10^{-19}$ sec.$^{-1}$ and $\lambda_{\mathrm{K}} = 5 \times 10^{-21}$ sec.$^{-1}$; but it is not therefore fixed that strictly the isotopes with the greater atomic weight are the carriers of the activity; for corresponding to the proportion of the mixture the decay probability would be greater and the half-value time smaller. Using the μ/ρ value measured by Campbell, which is deduced from the absorption in the layers of salt, an agreement with the half-value time determined by Mühlhoff is obtained.

J. J. S.

4225. Radioactivity of Potassium. G. v. Hevesy, W. Seith and M. Pahl. *Zeits. f. phys. Chem. Bodenstein-Festband, pp.* 309–318, 1931.—The radioactivity of ordinary and of heavy KCl was measured by means of a Geiger-Müller counter in order that the comparison might decide whether the radioactivity of K was to be ascribed to a hypothetical isotope of atomic weight 40. The result of the experiments showed that this could not be the case. The question of the transformation product of potassium is discussed. Since the solidification of the earth's crust, only about 0·0001 of the K can have been changed into Ca. J. J. S.

4226. Natural Ionisation of the Air with the Wilson Chamber. G. Orbán. *Akad. Wiss. Wien, Ber.* 140. 2*A*. 3–4. *pp.* 101–120, 1931.—Natural ionisation of the air was investigated with a Wilson chamber of 21 cm. diameter. The rendering visible of the ions was accomplished by using alcohol vapour; the Wilson arrangement being modified as follows: About 150 c.c. of thick oil was brought into the chamber and the detrimental portion of the space between head, chamber and expansion cylinder filled, and an even surface formed. Then 50 c.c. of absolute alcohol, blackened with a little aniline black, was poured on the surface of the oil. The oil surface was thus covered, and good saturation of the air in the chamber produced. The freedom to produce whirlpools was carried so far that a photograph of the β-paths was made possible with an exposure of 1 sec. It was noticed that α-courses, ¼ sec. after their appearance, caused a vortex in the chamber. Out of 131 Wilson photographs 693 β-courses of natural air ionisation were found to be present, of which 498 were in a straight line. The distribution of straight paths exhibited a spatial anisotropy with pronounced maxima. In some cases the back diffusion from the covering glass for the courses of rays coming from the base was observed. As regards the mechanism of the ionisation of the air in the chamber for the case in which twenty-two pairs of ions were present per c.c. per sec., the following result was obtained: In each ½ min. there passes through 1 c.c. one β-ray course. The mean length of the path amounts to about 6 m. The penetrating radiation liberates on the average in each hour in 1 c.c. of air one β-ray. Every three hours there goes through 1 c.c. one α-ray course. Notwithstanding the 400 times smaller occurrence, the ionising influence of the α-rays is of equal value to that of the β-rays. J. J. S.

4227. Absorption and Scattering of γ-Rays. J. C. Jacobsen. *Zeits. f. Physik*, 70. 3–4. *pp.* 145–158, *June* 27, 1931.—Absorption measurements of γ-rays from Ra and from MsTh'' respectively showed, in agreement with earlier results, that the increase is actually greater for the γ-radiation from ThC'' than for the γ-radiation from Ra. Contrary to the characteristic inconstancy in the change of the absorption with rising atomic number, which was recently found by Meitner and Hupfeld, the results show a constant rise of absorption per electron with the atomic number. J. J. S.

4228. Apparatus for Preparing RaB + C Sources. L. F. Curtiss. *Bureau of Standards, J. of Research*, 7. *pp.* 215–218, *Aug.*, 1931.—A simple glass apparatus is described which may be used to serve the purpose of an "emanation pipette," but which eliminates two objectionable features present in the usual forms of this apparatus. Mercury does not come in contact with rubber tubing, since no rubber tubing is used. A further improvement is accomplished by avoiding the necessity for passing mercury through stopcocks. AUTHOR.

HEAT.

4229. Viscosity, Thermal Conductivity and Diffusion in Gaseous Mixtures. Part XVII. Viscosity of NH_3 and Mixtures with H_2, N_2, O_2 and C_2H_4. M. Trautz and R. Heberling. *Ann. d. Physik,* 10. 2. *pp.* 155–177, *July* 3, 1931.—Accurate measurements of the viscosity of NH_3 and some binary mixtures are undertaken as examples of very imperfect gases. The transpiration method [see Abstract 440 (1926)] is used over the range 20–300° C. The results are from 2–3 % lower than those of other investigators, but agree with previous values obtained by the present authors. Corrections for the imperfect nature of the gases are applied, and Sutherland's constants and ratios of effective cross-sections of molecules are calculated. N. D.

4230. Viscosity, Thermal Conductivity and Diffusion in Gaseous Mixtures. Part XVIII. Viscosity of Aggressive Gases (Cl_2, HI). M. Trautz and H. Winterkorn. *Ann. d. Physik,* 10. 4. *pp.* 511–528, *July* 21, 1931.—The gas flows from a holder through a tap, a capillary tube and a second tap for a definite time. Measurements begin when the second tap is opened, and end when the first tap is closed. Initial and final pressures are measured by a quartz manometer. The method was checked by using air and sulphur dioxide, with which good agreement with accepted values was obtained. The viscosities of chlorine and hydriodic acid were measured over the range 0°–250° C. A comparison of the results for the latter with those of Harle [see Abstract 1444 (1922)] is made. N. D.

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4231. Temperature Coefficient of the Viscosity of a Gas. M. Trautz. *Ann. d. Physik,* 10. 3. *pp.* 263–264, *July* 11, 1931.—It is asserted that the temperature coefficient of the viscosity of a perfect gas at its critical temperature is given by the viscosity itself/critical temperature (absolute). This has been checked by means of available data. This simple relation indicates that the critical temperature is closely linked with the numerical values of physical quantities connected with the gas. N. D.

4232. Heat Loss from a Cylinder Embedded in an Insulating Wall. F. H. Schofield. *Phil. Mag.* 12. *pp.* 329–349, *Aug.*, 1931. *Supplement.*—The problem discussed is that of the steady flow of heat from an infinitely long circular cylinder with an isothermal boundary, embedded in an infinitely long wall with a rectangular isothermal boundary. For this two-dimensional problem the method of conformal representation is employed, taking the rectangular outer boundary and an imaginary inner isothermal boundary of such dimensions and shape that it yields a particular isothermal approximating, as closely as may be, with the required circle. Formulæ are derived for calculating the overall heat loss for cases where the axis of the cylinder lies either outside or in the mid-plane of the wall, and a complete distribution of isothermals and flow lines is calculated for two such cases. The distribution in these latter cases is compared with that given by a method of graphical estimation, and a determination of overall heat loss, based on electrical analogy, is given for one of the cases. An alternative method of theoretical treatment is also discussed. AUTHOR.

4233. Selective Thermal Radiation of Coloured and Pure Fused Quartz. R. W. Wood. *Phys. Rev.* 38. *pp.* 487–490, *Aug.* 1, 1931.—The peculiarity of pure fused quartz in that it does not visibly radiate at all until its temperature nears the fusion point is explained by the displacement, with increasing temperature, of the ultra-violet absorption band toward the visible. Quartz-neodymium rods, containing neodymium oxide, were prepared. When heated they emit a radiation consisting of seven distinct bands. The wave-lengths of the centres of the bands are 8730, 8270, 7504, 6717, 5944, 5340, 4570 Å. Absorption measurements show bands in the same positions. A method for preparing the neodymium quartz is described. AUTHOR.

4234. Deposition of Dust on Walls. W. J. Hooper. *Physics,* 1. *pp.* 61–68, *July,* 1931.—An apparent uncertainty exists in literature dealing with the cause for the peculiar deposition of dust on plaster and lath walls wherein the course of the laths and rafters behind the plaster is outlined in dust, popularly called "lath marks." Conclusive experimental proof of a thermal cause is given which is in agreement with the general theory of the behaviour of small particles suspended in an atmosphere in which a temperature gradient exists. Experimental evidence is produced to show that this phenomenon may be reduced to a negligible degree by thermal insulation. AUTHOR.

4235. Temperature Distribution in Solid Bodies During Heating or Cooling. J. B. Austin. *Physics,* 1. *pp.* 75–83, *Aug.,* 1931.—Most treatments of the problem of temperature distribution in a solid body during heating or cooling assume that the change in surface temperature is either instantaneous or linear with time. Experience shows that in many cases of practical importance the increase in surface temperature may be represented by a simple exponential function of the time. Equations for the distribution of temperature within a body when the surface is heated in accordance with this exponential relation have been derived for the following shapes: rectangular parallelepiped (brick); rectangular rod; slab; cylinder; cylindrical rod; sphere. These equations also represent the general case of diffusion under the given boundary conditions and apply, therefore, equally well to problems such as the diffusion of one substance into another, as, for instance, one metal into another. AUTHOR.

4236. Convection Motor. *Journ. Sci. Instruments,* 8. *pp.* 200–201, *June,* 1931.—A light drum, on a jewelled bearing, turns under the influence of convection currents (caused to take a suitable path by means of baffles). The apparatus is sufficiently sensitive to show movements in quite weak light, when temperature-rises of only half a degree are in question. When the light begins to fail, heat radiation is more rapid than absorption and the direction of rotation of the drum is reversed. J. H. A.

4237. Calorimeter for Measurement of Heat Evolution in Liquefied Gases. P. Chall and O. Doepke. *Zeits. f. Elektrochem.* 37. *pp.* 357–359, *July,* 1931.—A calorimeter is described in which heats of solution and similar constants in such fluids as ammonia may be measured, at or about room-temperature, where the pressure is of the order 8 or

10 atmospheres. The liquid ammonia itself is used as the calorimetric fluid, the calibration being carried out electrically. The heat of solution of NaCl in liquid ammonia at 20° C. was found to be 46 ± 2 cal. per gm.
J. H. A.

4238. Thermoelectric Reversible Spherical Actinometer. M. Robitzsch. *Zeits. f. Instrumentenk.* 31. *pp.* 369–373, *July*, 1931.—Difficulties which arise in other types of instrument are discussed. The construction and method of operation of a new type of actinometer are described. By the use of two thin hemispherical metal sheets which can be rotated under the slit the heat due to incoming radiation is conducted radially and not along a straight-line path to the heating filament. A reversible action eliminates errors which arise from external heat influences. The apparatus is quick in action and can be used on the ground or in flight.
R. S. R.

4239. Resistance Thermometers for the Measurement of Relative Humidity or Small Temperature Differences. D. C. Rose. *Canad. J. of Research,* 5. *pp.* 156–161, *Aug.*, 1931.—The instrument described in this paper was designed for the measurement of relative humidity in the slip stream of flying aircraft. As the temperatures to be measured are low, usually between 0° and −10° C., the temperature difference between wet- and dry-bulb thermometers is sufficiently small that, if mercury thermometers are used, in order to obtain the accuracy required, they would have to be of such fine bore that they could not be read from any distance. As a result wet- and dry-bulb resistance thermometers have been built connected to a special bridge circuit by means of which the temperature difference can be measured to 0·1° C. or better. The actual dry-bulb temperature can be read by a change in the circuit or by a mercury or alcohol thermometer of fairly large bore, which can be read at some distance. In the bridge circuit the two thermometers form two arms of a bridge so that temperature variations in the leads are automatically compensated. A slide wire forms a part of the bridge circuit and the constants are so arranged that a very simple relation gives the difference in temperature of the wet and dry bulbs. AUTHORS.

4240. Arc Temperature. L. S. Ornstein. *Phys. Zeits.* 32. *pp.* 517–520, *July* 1, 1931.—A review of experiments undertaken to determine the temperature in the arc spectroscopically. A. C. M.

4241. Nature of the Latent Heat of Fusion. K. Honda and H. Masumoto. *Tokohu Univ., Sci. Reports,* 20. *pp.* 342–352, *July,* 1931. *In English. Report No.* 268 *of the Research Inst. for Iron, Steel and other Metals.*—Starting from the idea of the "dynamic internal pressure," the latent heat of fusion has been calculated for 23 elements. It was found that the calculated values agree satisfactorily with those observed. From a thermodynamical consideration it was also concluded that the greater portion of the latent heat of fusion consists of the energy of atomic rotation. In the case of elements having a cubic lattice, some simple relations between various physical constants were found to exist. AUTHORS.

4242. Interchange of Molecules between a Liquid and its Vapour. T. Alty and F. H. Nicoll. *Canad. J. of Research,* 4. *pp.* 547–558, *June,* 1931.—The possibility of the reflection of vapour molecules at liquid surfaces has been examined and the reflection coefficients at the surface

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of water and of carbon tetrachloride have been measured. It is shown that, while there is very pronounced reflection at the surface of water, there appears to be very little, or none, at the surface of carbon tetrachloride. AUTHORS.

4243. Molecular Magnitudes and Phase Distribution. Part I. J. N. Brönsted. *Zeits. f. phys. Chem. Bodenstein-Festband, pp.* 257–266, 1931.—Isochemical substances are defined as those whose potential energies under similar conditions are proportional to the magnitudes of the molecules, or $\lambda = M\lambda_0$, where M is the magnitude (weight) of the molecule and λ_0 is a constant. Since isochemical liquids may be regarded as practically similar media, this expression may be introduced into Dieterici's equation [see Abstract 1183 (1911)], $-L = \alpha kT \log \frac{c_{(1)}}{c_{(2)}}$, where L is a constant fraction of the heat of evaporation, α is a constant having the mean value 1·73 and $c_{(1)}$ and $c_{(2)}$ are the concentrations in the vapour and liquid phases respectively. The resulting equation is $\frac{1}{M} \log \frac{c_{(1)}}{c_{(2)}} = \frac{K}{T}$, K being a new constant characteristic, like λ_0, of the isochemical group. Development of this equation renders it possible to calculate, for instance, the vapour pressure of normal cetane ($C_{16}H_{34}$) from that of normal octane, the value $5 \cdot 4 \times 10^{-4}$ mm. at T = 293° absolute being thus obtained. This pressure has not acually been measured, but it is known that increase of the number of carbon atoms in normal paraffins by one is accompanied by diminution of $\log p$ by 0·53 (at 20° C.); on this basis, the value $6 \cdot 0 \times 10^{-4}$ mm., which is in good agreement with that given above, is obtained. The marked influence of increasing molecular weight in depressing the vapour pressure is illustrated by similar consideration of the series, glycerin, mannitol, cane sugar. Various isochemical pairs of compounds, and also colloidal solutions, are also discussed in this connection. T. H. P.

4244. Influence of Intensive Drying on the Establishment of Internal Equilibrium. Part II. A. Smits, E. L. Swart, P. Bruin and W. M. Mazee. *Zeits. f. phys. Chem.* 155. *Abt. A.* 2. *pp.* 143–155, *July,* 1931.—The apparatus described previously [see Abstract 2351 (1931)] for removing all traces of gas from a liquid has been modified. Vapour pressure measurements with gas-free benzene, hexane and bromine after intensively drying for 11 months show that these liquids behave as unary substances. The complexity of so-called simple substances is discussed in detail; it is probable that vapour pressure and distillation observations are more adapted for studying complexity in the solid phase than in the liquid phase. H. F. G.

4245. Glass as Fourth State of Matter. E. Berger. *Zeits. f. techn. Physik,* 12. 7. *pp.* 344–363, 1931.—Thermodynamic consideration of the changes occurring in its various properties when a liquid cools to the glass or crystalline states leads to the conclusion that a glass is a quite definite and separate state of matter. Like the crystalline state, it is characterised by a zero-value of its molecular kinetic energy, which, however, is reached by continuous, and not discontinuous, processes. The glass state might be considered as a modification of the solid state, but never of the liquid state. C. B. A.

4246. Temperature Function in the Gas Equation, and Properties of the Electron. R. D. Kleeman. *Zeits. f. Elektrochem.* 37. *pp.* 371–373, *July,* 1931.—Considers the form of the function ϕ in the gas equation $pv^{1+a} = RMT\phi$ where p, v, R, M. T, have their usual meanings and a is a constant. The method is thermodynamical, taking a dissociating gas through a reversible cycle. J. H. A.

4247. Rôle of Quadrupole Forces in van der Waals' Attractions. H. Margenau. *Phys. Rev.* 38. *pp.* 747–756, *Aug.* 15, 1931.—Van der Waals' forces between atoms without permanent poles may be described as resulting from the interactions of multipoles associated with quantum transitions of the atoms. When the atoms are far apart, the dipole interaction is the only appreciable one. But at distances of the order of the kinetic theory radius, higher poles, usually neglected, must be considered. This paper examines and evaluates three terms of the series of interactions; the dipole-dipole, the dipole-quadrupole, and the quadrupole-quadrupole term, instead of the customary first term alone. The last appears to be in general small, but the dipole-quadrupole term requires consideration. Its effect is illustrated by plotting the potential energy curve for two helium atoms (*a*) neglecting the term, and (*b*) including it. The method outlined permits an easy estimate of dipole and quadrupole forces for all substances for which the wave function of only the normal state is known. AUTHOR.

4248. Constants of van der Waals' Equation. S. Ray. *Kolloid Zeits.* 56. *pp.* 159–166, *Aug.*, 1931.—The van der Waals constants for a large number of gases are tabulated and the ratio $a : b$ evaluated. The probability that all the experimenters would find that a/b is practically the same, even when a and b deviate appreciably, indicates no mere chance. When a great deviation of a/b occurs, a specific atomic character is denoted. The explanation of the general constancy of a/b and of the characteristic deviations is to be found in the colloid theory of gases.
H. H. Ho.

4249. Van der Waals' Equation and the Boundary between the Homogeneous and Heterogeneous Regions. D. P. Misra. *Tokoku Math. J.* 34. *pp.* 328–348, *Aug.*, 1931. *In English.*—A simple analysis of van der Waals' equation shows that it has no physical significance at temperatures below (27/32) θ_c, where θ_c is the critical temperature. The equation of the boundary in the p-v diagram of the region in which the substance coexists in the gaseous and liquid states is then found. For this purpose, use is made of the principle that if A and B are the terminal points of the constant-pressure portion of an isothermal found by experiment, then between these two points the isothermal deduced from van der Waals' equation is a curve. The work done, however, in expanding from A to B is the same, by whichever route the expansion progresses. By introducing a parameter to be determined subsequently from available data the required equation for the locus of A and B is obtained for the first time. Consideration shows, however, that it includes portions other than the locus. These parts have been introduced by the mathematical method, which does not distinguish between physically significant points and others. J. P. A.

SOUND.

4250. Sound Waves Due to the Vibration of a Spheroid in Presence of a Rigid and Fixed Spheroidal Obstacle. H. Sircar. *Calcutta Math. Soc., Bull.* 23. *pp.* 85–100, *June,* 1931.—An attempt to work out mathematically the wave system resulting from the motion of a spheroid parallel to its axis of revolution, and also the scattering of such a system by a fixed, rigid spheroid having a common axis of revolution. G. E. A.

4251. Measurements of Sound Reflection Coefficients of Materials for Defined Sound-Field Ratios. L. Casper and G. Sommer. *Wiss. Veröff. a. d. Siemens-Konzern,* 10. 4. *pp.* 117–127, 1931. —Three methods of measuring sound reflection coefficients of building materials for defined sound-field ratios are described and explained. The sensitivity of West's method (method I) was increased by the use of a velocity microphone of smaller dimensions in connection with an amplifier. The determination of the reflection coefficient, by method II, of the near end of the resonance tube makes the measurement of high reflection coefficients possible. Assuming plane waves, a relation is deduced between the ratio of pressure amplitudes at two points of the sound field and the reflection coefficient k of the material under test. Method III was used to verify this relation for the case of a rigid wall, for which k can be taken as unity. Results were then obtained for a number of different materials, such as wood, plaster and wadding, by the same method; these are tabulated. A. W.

4252. Bibliography of Acoustics of Buildings. F. R. Watson. *Acoustical Soc. of. America, J.* 3. *Pt.* 1. *pp.* 14–43, *July,* 1931.

4253. Precision of Measurement of Absorption Coefficients by Reverberation Methods. P. E. Sabine. *Acoustical Soc. of America, J.* 3. *Pt.* 1. *pp.* 139–154, *July,* 1931.—A discussion based on the measurement of the absorption coefficients of four materials at five different frequencies. The conclusions are that the computation of the time of reverberation is a matter of only approximate estimate, that considerable variation in coefficients may exist without appreciably affecting the acoustic properties of rooms, and that present methods, when used with skill and care, give coefficients which are sufficiently precise for application in practice. G. E. A.

4254. Audible Frequency Ranges of Music, Speech and Noise. W. B. Snow. *Acoustical Soc. of America, J.* 3. *Pt.* 1. *pp.* 155–166, *July,* 1931.—An account of tests made to establish the audible frequency ranges of the sounds most frequently encountered in sound reproduction. The sounds were transmitted through an electro-acoustic system equipped with electrical filters by means of which all frequencies above or below any desired value could be suppressed, and observers determined the high and low frequency cut-offs causing just perceptible differences in the transmission. Orchestral instruments of all kinds were used as sources, also male and female speech, footsteps, hand-clapping and key-jingling. Among the results it is noted that the piano alone produces tones with inaudible fundamentals. In general, musical instruments give audible frequencies down to 40, but reproduction down to 60 was considered almost as satisfactory. Transmission of the highest audible frequencies is needed for the perfect reproduction of noises, and also of musical instruments mainly because of the accompanying noises. A 10,000-cycle cut-off had slight effect on the tone quality of most instruments. [See also Abstract 2374 (1931).] G. E. A.

4255. New Acoustic Analyser. Sound Spectra Produced by Aircraft in Flight. L. P. Delsasso. *Acoustical Soc. of America, J.* 3. *Pt.* 1. *pp.* 167–178, *July*, 1931.—The mechanical resonant system of the analyser consists of a small aluminium needle with mirror, suspended from one wire and held by two others used as bifilar stays. The sound waves are converted into fluctuations of potential by a microphone and amplifier, and the output of the amplifier is applied to a system of quadrants which act electrostatically on the needle. The resonance frequency is noted by the spread of the image produced by the mirror, and its value is read off the micrometer head which controls the tension of the suspension system. The range of the analyser is from 20 to 550 d.v./sec. A record is given of the sound spectrum of a blimp; in it frequency components are prominent which are even multiples of the angular velocity of the propeller. G. E. A.

4256. Sound, Sand and Smoke. E. N. da C. Andrade. *Roy. Inst. Proc. Advance proof. Received Aug.* 20, 1931.—The paper discusses the use of particles of various kinds in elucidating certain sound problems. Chladni figures were produced by acting on a steel plate with a magnet connected to an oscillator circuit. Measurements showed that the acceleration of the plate at the edge of the sand pattern is equal to *g*. Savart found that lycopodium powder on the Chladni plate moved towards the antinodes, and Faraday stated that this was due to air currents. The author has found that, in the absence of air, light powders also move to the nodes. In the case of the Kundt tube, the motion of the air can be made out by means of smoke, the particles of which describe paths of length equal to the range of vibration of the air. That dust particles form "eyes" at the nodes and discs at the antinodes was demonstrated by means of kinematograph films. Dust ridges are formed only if the intensity of the sound exceeds a certain value. The presence of an obstruction in the tube causes vortex motion to be set up, if the vibrations are sufficiently vigorous, and it is concluded that dust ridges are due to vortex systems formed round dust particles. G. E. A.

4257. Ultrasonics. Some Properties of Inaudible Sound. F. L. Hopwood. *Roy. Inst., Proc. Advance proof. Received July*, 1931.—The oscillator used was a quartz disc 7 cm. in diameter and 5 mm. thick connected to a 3-kW valve oscillator. Stationary waves set up in an oil tank are rendered visible by means of coke dust. The waves are made use of to demonstrate reflection, refraction, total internal reflection, interference, radiation pressure, and other wave properties. Some of the effects noted by Wood and Loomis are repeated [see Abstract 3165 (1927)], and additional effects are obtained such as acoustic distillation, anomalous movement of lycopodium and others. Biological effects of the ultrasonics are: breaking up of blood corpuscles, liberation of dissolved gases, paralysis of muscle and nerve, localised mechanical action and heat production. G. E. A.

4258. Speed of Ultrasonic Waves in Air. P. T. Kao. *Comptes Rendus*, 193. *pp*. 21–22, *July* 6, 1931.—Using Pierce's method [see Abstract 341 (1926)], the author finds that an inversion of the secondary maxima and of the plate-current maxima takes place for positions of the reflector close to the quartz. The speed found is 331·85 m./s. for frequencies between 40 and 1000 kc./sec. No appreciable dispersion was observed.

G. E. A.

4259. Absorption of Ultrasonic Waves by Water. P. Biquard. *Comptes Rendus*, 193. *pp*. 226–229, *July* 27, 1931.—The emitter was a quartz disc placed in an oscillating circuit excited on an odd harmonic of the fundamental frequency. The pressure of the waves was measured by their effect on a torsional pendulum on a vertical axis, and was proportional to the square of the tension applied to the quartz. The pressure p changes with the distance x from the source according to the law: $p = p_0 e^{-2\alpha x}$, where the coefficient α is 0·0174 for a frequency $7 \cdot 55 \times 10^6$, and 0·020 for $7 \cdot 97 \times 10^6$. G. E. A.

4260. Canonical Transformation and the Vibrations of a Loaded String. R. B. Lindsay. *Phys. Rev.* 38. *pp*. 491–500, *Aug*. 1, 1931.—The classical method of discussing the transverse motion of a finite string of negligible weight fastened at the ends with tension τ and loaded with particles of equal mass m, equally spaced at distance a, is that in which the Lagrangian equations for a system of n degrees of freedom are set up and integrated by means of determinant analysis. In the present paper it is shown that if we denote the coordinate and conjugate momentum of the sth particle by $q_s p_s$, we can find a function $S(q_s, Q_s)$ defining a canonical transformation to the set Q_s, P_s, which transforms the Hamiltonian of the dynamical system (neglecting dissipation) into the particularly simple linear form $H = \Sigma_{s=1}{}^n \omega_s P_s$. The ω_s are the characteristic frequencies of the loaded string (multiplied by 2π), and the usual solution is then obtained very easily from the fact that the P_s, Q_s are action and angle variables. The initial conditions are discussed. The transition to the case of the continuous string is made by finding the transformation functional S analogous to S and the corresponding canonical transformation. The wave mechanics quantisation of the loaded string is carried through, the quantised energy values appearing in the form $E = \Sigma_{s=1}{}^n (n_s + \frac{1}{2}) h\omega_s / 2\pi$.

AUTHOR.

4261. Longitudinal and Radial Vibrations of Liquids in Cylindrical Tubes. G. S. Field. *Canad. J. of Research*, 5. *pp*. 131–148, *Aug*., 1931.—The boundary conditions at the tube wall are considered taking into account the natural frequency of the wall itself. An expression is derived for the radial displacement of the wall due to the excess pressure acting in the liquid. A formula is developed for the resonant frequencies of radial vibration in the cylinder of liquid. For tubes of ordinary size these lie well up in the ultrasonic frequencies. The character of a longitudinal sound wave in tubes of liquid is analysed. Selective absorption of the longitudinal vibration is found to occur at the natural frequency of the radial vibration of the column of liquid. Examination of the expression for particle velocities reveals that the vibration for low frequencies is of a different type from that for high. AUTHOR.

ELECTRICITY AND MAGNETISM.

ELECTROSTATICS, TERRESTRIAL ELECTRICITY AND MAGNETISM.

4262. Dielectric Constant and Contact Potential. T. Takéuchi. *Phys. Math. Soc. Japan, Proc.* 13. *pp.* 208–210, *July,* 1931. *In English.* —The author has attempted to introduce the term of induced dipoles into the expression of refractivities of the electronic wave and has suggested some methods of determining the dielectric constants of metals *via* the photoelectric and thermoelectronic effects. H. H. Ho.

4263. Dependence on Frequency of the Dielectric Constant and the Damping of Solid Insulators. R. Weber. *Zeits. f. Physik,* 70. 11–12. *pp.* 706–710, *July* 29, 1931.—Measurements were made of the dependence on frequency of the dielectric constant and the damping of solid insulating materials in the region of $\lambda = 200$ m. to $\lambda = 1000$ m. (300 to 1500 kc.), the conductivity being compensated. Strongly marked maxima were found both of the dielectric constant and of the damping in the case of the materials examined, ebonite, vulcanite fibre and glass. J. J. S.

4264. Dielectric Constants of Aqueous Solutions. R. Weber. *Zeits. f. Physik,* 70. 11–12. *pp.* 711–722, *July* 29, 1931.—An apparatus is described which permits in the absence of air the distillation of pure water, the formation of solutions and the filling into the measuring condenser. Results are given which show the dependence on concentration of the dielectric constant of various electrolytes and of some non-electrolytes. A comparison with the results of other observers allows the presumption that there exists in the case of electrolytes a dependence on frequency of the dielectric constant, which is greater than would be expected from Debye's theory. The dependence on temperature of the dielectric constant and the conductivity were determined for water, urea solutions of various concentrations, and for a solution of lanthanum nitrate. The results are shown in tables and diagrams. J. J. S.

4265. Electric Discharge through Ebonite. A. Courtener and J. Ignatowitsch. *Ann. d. Physik,* 10. 6. *pp.* 681–694, *Aug.* 11, 1931.—The experimental data collected in this paper are compared with those from ceresine and paraffin [see Abstract 575 (1931)], and the connection thereby indicated is important in view of the chemical and mechanical differences between the dielectrics themselves. Dependence of the amount of electricity in the dielectric upon the influence of the external field is shown. The dependence of polarisation on the magnitude and time of action of the external field has been studied and regularities established. Various kinds of ebonite have been employed. H. H. Ho.

4266. Electrical Properties of Micas. A. B. Lewis, E. L. Hall and F. R. Caldwell. *Bureau of Standards, J. of Research,* 7. *pp.* 403–418, *Aug.,* 1931.—A number of samples of mica, fairly representative of the major sources of the world's supply, have been tested for dielectric constant, power factor, dielectric strength, and ability to withstand

elevated temperatures. The results of these tests are as follows: For clear ruby muscovite, in the frequency range from 100 to 1000 kc., a dielectric constant of 7·2 and a power factor of 0·02 % may be expected on the average. Individual samples may be expected to vary on the average from these values by ± 0·3 in dielectric constant and ± 0·01 % in power factor. The presence of stains or inclusions so seriously affects the power factor as to render such stained micas unsuited for radio purposes. The power factor of phlogopite is found to be so high as to render it unsuited for radio purposes. The dielectric strength of mica is found to be relatively unaffected by the presence of air bubbles, and but slightly affected by the presence of moderate amounts of stains in the form of metallic oxides. Curves showing the average dielectric strength of various classes of mica as a function of the thickness of the specimen are given. With but two exceptions all the micas investigated were unaffected by an exposure to a temperature of 600° C. for 30 min. Above that temperature the phlogopites withstood heating better than did the muscovites. In none of these tests was it possible to make any distinction between the various micas based solely on the geographical origin of the samples.
AUTHORS.

4267. Dielectric Polarisation. Part I. Benzene Solutions of Furan, Ethyl Mercaptan, and Ethyl Sulphide. E. C. E. Hunter and J. R. Partington. *Chem. Soc., J. pp.* 2062–2070, *Aug.*, 1931.—Measurements, with method, are recorded for the dielectric constants and densities of dilute benzene solutions of ethyl mercaptan, ethyl sulphide, and furan, and for the molecular refractions of the pure compounds. The dipole moments have been calculated on the Debye theory, and compared with those of analogous oxygen and sulphur compounds. The sulphides have higher moments than the corresponding ethers, but the mercaptans have lower moments than the alcohols. The degrees of association of the alcohols are higher than for the mercaptans, and this is the order of the moments. The group moments of HS and EtS and the moment of ethyl sulphide have been calculated by the theory of vector moments, and an increase in moment has been found on substituting ethyl for hydrogen in the sulphur compounds which is not found in the oxygen series.
H. H. Ho.

4268. Configurations of Oximes, from Measurements of Electric Dipole Moment. L. E. Sutton and T. W. J. Taylor. *Chem. Soc., J. pp.* 2190–2195, *Aug.*, 1931.—The method now described has been used to obtain the dipole moments of the *n*-methyl ethers of the two isomeric oximes of *p*-nitrobenzophenone, since the oximes themselves are largely associated in solution, thus rendering them unsuitable for measurements. The constitutional problem is then discussed.
H. H. Ho.

4269. Dipole Moment, Spatial Structure and Energetic Considerations of Inorganic Halides. E. Bergmann and L. Engel. *Zeits. f. phys. Chem.* 13. *Abt. B.* 3. *pp.* 232–267, *July*, 1931.—The dipole moments of boron trichloride, phosphorus trichloride, phosphorus tribromide, arsenic trichloride, arsenic tribromide, antimony trichloride, silicon tetrachloride, titanium tetrachloride, tin tetrachloride, antimony pentachloride and iron pentacarbonyl have been measured and conclusions drawn from the data with respect to their spatial structure, the results being compared with those of previous investigators. Comprehensive details are given of the methods and apparatus employed. It is indicated that the trihalides are three-sided pyramids, and that, of the tetrahalides, stannic chloride possesses a finite dipole moment and a pyramidal form, whereas silicon and titanium tetrachlorides are dipole free and tetrahedral. From energetic considerations a new method is evolved for the determination of atomic radii. H. H. Ho.

4270. Electric Moments of Polymorphic Dimethyl Tartrates and the Existence of Racemic Compounds in Solution. A. Weissberger and R. Sängewald. *Zeits. f. phys. Chem.* 13. *Abt. B.* 4–5. *pp.* 383–386, *Aug.*, 1931.—This paper records a continuation of the work [see Abstract 3548 (1931)] on the relationship between dipole moment and structure of organic compounds whereby it is established that the electric moments of the polymorphic dimethyl tartrates are identical. A comparison of the molecular polarisations of the dimethyl esters of tartaric and of racemic acid, as also of the methyl esters of *d*- and *d, l*-mandelic acid, has not given definite information for the existence of racemic compounds in solution. H. H. Ho.

4271. Dipole Measurements of Benzene Derivatives. Part I. L. Tiganik. *Zeits. f. phys. Chem.* 13. *Abt. B.* 6. *pp.* 425–461, *Aug.*, 1931. From 47 dipole moments of halogeno-, nitro-, and methyl-substituted benzene derivatives, such regularities occur as enable conclusions to be drawn respecting valency direction, especially in the cases of the hexa-substituted compounds. The Smallwood-Herzfeld mode of evaluating the dipole moment is established. H. H. Ho.

4272. Dipole Moments of Dichloropropanes. P. Gross. *Phys. Zeits.* 32. *pp.* 587–592, *Aug.* 1, 1931. *Paper read before the Deut. Phys. Gesell., Jena, May and June,* 1931.—This work continues a previous investigation [see Abstract 2032 (1930)] and records the measurements of the dielectric constants and densities of dilute benzene solutions at 25° C. of 1: 1- and 1: 2-dichloroethane, 1: 1-, 2 : 2-, 1: 2- and 1: 3-dichloropropane, from which the dipole moments are evaluated by the usual Debye equation. Various structural questions are then discussed. H. H. Ho.

4273. Dependence of the Normal Earth Current on Latitude. D. Stenquist. *Terr. Mag.* 36. *pp.* 105–109, *June,* 1931.—The author has previously investigated the diurnal variation (inequality) of the earth current as a function of latitude, and he now in this paper gives an account of further study of the great number of observations from Sodankyla in which classification is made of the days of the year September, 1882, to August, 1883. The results are given in tables and in curves. The diurnal inequalities can be represented in Fourier series. The observations at Lund from August, 1924, to July, 1927, have also been arranged and classified, though the latter process is more difficult, the observations being not so well adapted for classification. These Lund diurnal inequalities are represented in Fourier series, which are given in the paper. The directions of the average earth current are discussed, and the recurrence of definite inequalities at Kew and elsewhere is referred to. It is conceivable that diurnal inequalities of the low-latitude type for earth currents and for the magnetic elements are connected with the ultra-violet radiation of the sun, that the high-latitude type is connected with ordinary auroral rays having diurnal variation, and that the magnetic storms are connected with the cosmic rays, which have diurnal variation. J. J. S.

4274. Absorption and Diffusion of Penetrating Corpuscular Radiation in Lead and in Iron. B. Rossi. *Accad. Lincei, Atti*, 13. *pp.* 600–606, *April* 26, 1931.—Referring shortly to Steinke's recent study of the absorption curves of the penetrating radiation (cosmic rays) and to the characteristic anomalies occurring on the passage from one medium to another (transition effect) [see Abstract 1296 (1931)], the author describes a research on the absorption and diffusion of the corpuscular radiation in lead and in iron, substances in which, according to Steinke, the absorption curves present characters notably different. The results of the experiments, which were carried out using Geiger and Müller's tube counters and screens of lead and iron, are given in a table. These results do not show the difference in behaviour of the two metals which Steinke noted. The author suggests that perhaps Steinke's apparatus registered some other soft γ-rays besides the corpuscular radiation and that this alien effect caused the apparent anomalies. There remains the question whether the phenomenon is due to the passage of the radiation from air into lead, or whether it may be explained as due to a simple filtration effect, whereby the first centimetres of lead stop the softer components of the corpuscular radiation, as might do an equivalent layer of some other material. J. J. S.

4275. Ultra-Penetrating Rays. *Roy. Soc., Proc.* 132. *pp.* 331–352, *July* 2, 1931.—A record is given of a discussion on ultra-penetrating or cosmic rays, held on May 14, 1931, under the presidency of (Lord) Rutherford. This was opened by **H. Geiger,** who gave a summary of the experiments carried out during the last 20 years and some of the hypotheses founded thereon. The first fundamental experiments made by Hess, and improved on by Kolhörster, in which an airtight electrometer registered the ionisation current at different altitudes showed that the current increased with the altitude and revealed the presence of an extremely penetrating radiation markedly absorbed by the atmosphere. After years of experiment it was found that the penetrability is about ten times greater than the hard γ-rays of radium and that the ionisation in air at sea-level is slightly more than 1 ion per sec. per c.c. Recently progress has been made towards solving the problem by electrometric methods with improved registration and the application of high pressure chambers, and by the method of electron counting by Geiger's tube counter. The absorption experiments of Millikan and others have been extended by Regener, who lowered self-registering apparatus to depths of 236 m. in Lake Constance. In a pressure-chamber with quartz-fibre electrometer attached the deflections were photographically recorded every hour by the automatic illumination of the quartz-fibre. In another set of experiments Regener replaced the ionisation chamber by an electron counting tube, the record being made by a small adding machine. On the surface such a counter registered about 8000 electrons an hour, but at a depth of 235 m. only 13. Both methods gave an absorption coefficient of $0 \cdot 020$ per m. water. Thus a thickness of 35 m. water is necessary to absorb half of this radiation. Hence by the Klein-Nishina formula the wave-length is $0 \cdot 63 \times 10^{-13}$ cm. From the experiments of Bothe and Kolhörster, later extended by Rossi, in which the coincidences of two neighbouring tube counters were observed, a completely different aspect of the nature of the ultra-radiation is indicated. These appear to show that the radiation is not of a wave nature, but consists rather of high-velocity electrons. A third group of experiments dealing with

transition effects, carried out by Hoffmann, Steinke, Myssowsky and others, detected absorption anomalies on the passage of ultra-radiation from one medium to another, *e.g.*, on passing from Al to Pb the radiation is more highly absorbed in the first stages of transition through the second medium. Each type of experiment mentioned leads to the consideration of the radiation in a different light, *viz.*, as waves, electrons or material particles. **E. Regener**, in a contribution sent to the discussion, suggested that cosmic rays consist of radiation reaching the earth from the stellar system, not directly but the other way round the universe sphere. **(Lord) Rutherford** deprecated too much speculation on the question. Speculations are of value only in so far as they encourage experimental research on this difficult question. Now due to Millikan's and Regener's fine experiments, for the first time a curve of absorption of these radiations in water has been obtained which may safely be relied upon. To him it seemed that the penetrating radiation must be considered as of the γ-ray type until there is definite evidence to the contrary. **F. A. Lindemann** said that the total energy of the cosmic radiation seems to be of the order of one-tenth the total energy of the starlight. If it were produced in the heavenly bodies an enormous diurnal effect might be expected, and this does not appear to exist. **C. T. R. Wilson** said that thus far there is no direct evidence that thunderstorms produce any appreciable amount of penetrating radiation, but gave some reasons for not altogether ignoring thunderclouds as possible sources of such radiation. **L. H. Gray** and **G. T. P. Tarrant** referred to certain results obtained concerning the interaction between γ-rays and atomic nuclei which may throw light on the transition phenomena. **A. Eddington** considered the only reasonable astronomical source is an outpouring of this radiation in the galaxies or between them, and that this is running round and round in the universe.
J. J. S.

4276. Insulation of Apparatus for Measuring High-Altitude Radiation. W. M. H. Schulze. *Phys. Zeits.* 32. *pp.* 564–567, *July* 15, 1931.—The author has calculated the leak at the insulator of the ordinary Kolhörster apparatus, which employs a bent quartz rod about 4 cm. long for the purpose. He makes use of the measurements carried out on quartz by Gnann, and finds that, in the conditions existing in the Kolhörster apparatus, the calculated leak is negligible compared with the currents due to ionisation. He suggests, however, the possibility of reducing the effect of the insulation leakage by the known method of dividing the quartz rod into two pieces, and joining them by a metal " guard body," the capacity of which with respect to the container is of the same order of magnitude as that of the electrometer system with respect to the container. An arrangement must be made to bring the guard body to the same potential as the system.
H. N. A.

4277. Pulsations of Terrestrial Magnetism. C. Störmer. *Terr. Mag.* 36. *pp.* 133–138, *June*, 1931.—Twenty-five years ago the author suggested that the action of clouds of electric corpuscles moving along periodic orbits in space far away from the earth might account for the terrestrial-magnetic disturbance known as Eschenhagens' waves. Last year a long series of periodic orbits of corpuscles moving in the earth's magnetic field were calculated, and in this paper further details are given of the computed periods of these corpuscular orbits. A corrected copy of the pages (pp. 135–138) has been subsequently given, and the author calls attention to the fact that there are an infinite number of more complicated periodic orbits which have not been considered in the paper, and the periods of the orbits merge continuously in each other, as do the orbits themselves. J. J. S.

CURRENT ELECTRICITY, MAGNETISM, AND ELECTROMAGNETISM.

4278. Electric Conductivity and Optical Absorption in Metals. E. H. Hall. *Nat. Acad. Sci., Proc.* 17. *pp.* 392–401, *June, and pp.* 427–430, *July*, 1931.—It is suggested that the conduction electrons in metals may be those which execute transits from atoms to adjacent ions, together with a few of the so-called "free" electrons. Drude's fundamental equation of motion of an electron activated by a light wave is applicable to such "transit" electrons. W. Meier [see Abstract 819 (1910)] found that the conduction electrons in a certain set of metals were about equal in number to the atoms, and reasons for supposing that the former can be identified with the transit electrons are given. A formula for the transit conductivity obtained by the author gives results agreeing with those derived from one given by J. J. Thomson. In particular, it indicates that when the ratio of wave period to transit period drops from 10 to 1, the absorptive power of the transit electrons drops from 97 % of its maximum value to zero. The author concludes from Meier's work that for wave-lengths of 4 μ or more the transit conductivity and absorptive power are almost equal to their values for steady currents. The theory also gives a reasonable explanation of results found by Rubens and Hagen indicating that for wave-lengths 4 μ, 8 μ and 12 μ falling on various pure metals and alloys the "absorption conductivity" is somewhat less than the steady current conductivity. In the second paper an expression for the ratio of the transit conductivity to the steady current conductivity is deduced and several numerical examples are worked out. The transit conductivity is shown, in optical experiments, to be dependent upon the ratio of the wave period to the transit period, in the same general way in which, according to Thomson's formula and others, free-electron conductivity is dependent upon the ratio of the wave period to the free-path period. N. D.

4279. Electrical Conductivity of Gold-Nickel Alloys. G. Grube and F. Vaupel. *Zeits. f. phys. Chem. Bodenstein-Festband, pp.* 187–197, 1931.—With the object of establishing what reactions take place upon the disintegration of the homogeneous mixed crystals in the Au-Ni system, the temperature-resistance curves in the region from 20° to 900° C. were measured. From the results, the conclusion is drawn that in consequence of decreasing mutual solubility as the temperature is lowered the homogeneous mixed crystals in a heterogeneous mass of crystals, rich in Au and in Ni respectively, disintegrate; and the limits between the homogeneous and the heterogeneous region are given. Confirmation is given, by the course of the temperature-resistance curves over a wide concentration region, of the condition-diagram of Fraenkel and Stern. As to the existence of the two eutectoid horizontals, assumed by Heike and Hafner, no fact was found which would tend to prove this from the resistance measurements. J. J. S.

4280. Electrical Conductivity of Single Aluminium Crystals in Directions Inclined at Various Angles to the Crystal Axes. M. Fraser. *Phil. Mag.* 12. *pp.* 112–129, *July*, 1931.—The specific resistance of a single crystal of aluminium is independent of the direction in which it is measured. This result is in agreement with the theories of Drude, Bridgman and Sommerfeld. The specific resistance of a single crystal is found to be about 1 % greater than that of the annealed test piece from which it was made, a result which is explained by assuming that prolonged annealing causes the impurities to go into solid solution.

F. J. W.

4281. Dependence of Conductivity on Field Strength in Rock-Salt Crystals. B. Hochberg. *Zeits. f. Physik*, 70. 9–10. *pp*. 635–640, *July* 22, 1931.—It is shown that the deviations from Ohm's law which appear in natural rock-salt crystals entirely disappear after tempering up to temperatures near the melting point. J. J. S.

4282. Validity of Ohm's Law for Cuprous Oxide. E. Engelhard and B. Gudden. *Zeits. f. Physik*, 70. 11–12. *pp*. 701–705, *July* 29, 1931.—Reference is made to Auerbach's paper on "Variable Resistances and their Hydrodynamic Analogies" [see Abstract 1626 (1931)], from which it might be concluded that the specific resistance of Cu_2O decreases with increasing load. In agreement with earlier results such as those of Vogt, the authors find from new measurements that there is no experimental support for such a hypothesis. Moreover, from theoretical considerations it is improbable that Ohm's law should not hold for Cu_2O. J. J. S.

4283. Resistivity of Single Crystal Zinc. E. P. T. Tyndall and A. G. Hoyem. *Phys. Rev.* 38. *pp*. 820–827, *Aug*. 15, 1931.—Measurements of specific resistance as a function of orientation check the Voigt-Thomson symmetry relation accurately for crystals made from Kahlbaum's best zinc. The principal resistivities are: $\rho\| = 6\cdot20^2$ and $\rho\perp = 5\cdot86^8 \times 10^{-6}$ ohms/cm.³, with the ratio $\rho\|/\rho\perp = 1\cdot057$. For "spectroscopically pure" zinc the majority of the crystals yield consistently the same value of $\rho\|/\rho\perp$, with $\rho\|$ and $\rho\perp$ each about 0·6% lower than for the Kahlbaum zinc crystals. A few crystals of the S.P. zinc give anomalous results of a type previously found by Bridgman. The disagreement between the writer's values (particularly of $\rho\|$ and $\rho\|/\rho\perp$) and Bridgman's most recent values does not seem explicable in terms of an effect on resistivity of strain, but rather must be ascribed to differences in the crystals caused by some as yet unknown conditions governing the crystal growing process. AUTHORS.

4284. Demonstration and Study of the Peltier Effect. U. P. Lely. *Zeits. f. Physik*, 70. 7–8. *pp*. 562–563, *July* 14, 1931. *Phil. Mag.* 12. *pp*. 488–490, *Aug*., 1931.—A rod is made up of three equal parts (dia. 7 mm., length of each part 10 cm.); the two end portions are of copper, the middle of iron. The two ends are connected to a galvanometer of moderate sensitiveness and the rod is heated unsymmetrically. Then the galvanometer indicates a current which varies in direction according to the sense of the asymmetry and whose strength increases with the asymmetry. The details and meaning of this experiment are discussed in this short paper. J. J. S.

4285. Maximum Value of the Intensity of Current at the Beginning of a Discharge. G. Valle. *N. Cimento*, 8. *pp*. 194–204, *May*, 1931.—The results are given of the study of the dependence of the maximum intensity that the current attains during the process of rise of the flash discharge upon the constants of the supply circuit. Moreover, it is shown that the density of the current at the kathode increases even during this very rapid process up to the attainment of the normal according to the Hehl-Wilson law for the flash discharge in the stationary state, a value which may remain constant if the kathode is not completely covered. Two different modes of rise are distinguished, direct and indirect according as the density of the normal current is reached before or after the discharge current has increased up to the value of the supply current.

J. J. S.

4286. Experiments on the Glow Discharge. G. Valle. *Accad. Lincei, Atti,* 13. *pp.* 595–600, *April* 26, 1931.—A record is given of the observations and results obtained in a research on the passage of electricity through rarefied gases in the glow discharge phase. First the phenomena of the various types of stationary condition in the glow discharge were investigated; and next the maximum value of the current attained at the beginning of the discharge was examined. Of the relations that contribute to the determination by calculation of i_μ, the maximum current, one only is known, $dV/dt = (i_s - i)/C$, if the mode in which the current increases with time when the discharge commences is unknown. Thus it is of interest to determine experimentally i_μ and its dependence on i_s, the subnormal current, and on C, the capacity of the discharge tube. An account is given of experiments made with this object and of some results.

J. J. S.

4287. Probe Characteristics and the Hindered Arc Discharge. M. Wehrli and P. Bächtiger. *Helv. Phys. Acta,* 4. 5. *pp.* 290–302, 1931. *In German.*—In an arc discharge, with tungsten electrodes in nitrogen, measurements were made of the probe characteristics as functions of the pressure for the pressure range 20·6 to 457 mm. The complex curve form varies with the pressure in the same way as for displacement of the probe along the axis of the arc. This similarity can be explained by the mechanism of the hindered arc discharge and leads to a new confirmation of space potentials. The minimal potential of 192 volts determined from the potential-arc length curve agrees with the kathode fall to ± 4 volts. The positive ion current density exhibits a marked increase in front of the kathode. This increase begins at the distance within which the anode fall of potential can no longer develop. [See also Abstract 3524 (1930).]

A. W.

4288. Fall of Potential in Initial Stages of Electrical Discharges. J. C. Street and J. W. Beams. *Phys. Rev.* 38. *pp.* 416–426, *Aug* 1, 1931.—The fall of potential in the initial stages of condensed discharges through air, nitrogen, hydrogen and CO_2 has been studied as a function of the pressure. The experimental method consisted in measuring the magnitude and shape of the potential wave impressed upon two parallel copper wires attached to the electrodes of the discharge. In every case the rate of potential fall was increased with increase of pressure. Over the pressure range studied (50 to 140 cm. of mercury) the decrease of potential was slowest in CO_2 of the gases quantitatively studied. However, rough measurements showed the rate of fall to be very much slower in helium than in CO_2. In hydrogen a small over-voltage produced an increase in the rate of potential fall at all pressures. The results are shown to be in good agreement with Toepler's discharge law. A method is described by means of which it is possible to apply 5×10^5 volts/cm. across a spark gap in air, hydrogen or nitrogen at atmospheric pressure at least 10^{-6} sec. without electrical breakdown. When such discharges once are initiated the potential falls much faster than for a static breakdown. AUTHORS.

4289. Kathode Fall of an Arc. R. C. Mason. *Phys. Rev.* 38. *pp.* 427–440, *Aug.* 1, 1931.—The distribution of energy of electrons at the boundary of the kathode fall of an arc is worked out for the thermionic arc and for the high field arc upon both the classical Schottky theory and the quantum mechanical theory of high field emission. For the same value of kathode fall, the electrons from the thermionic arc have energies several volts greater than those from the high field arc. To give the positive ions necessary for space charge purposes, the kathode fall of the high field arc consequently must be several volts greater than that of the thermionic arc, if the mechanism of production of positive ions is the same in the two arcs. The minimum value of the difference in kathode fall is 4 to 6 volts. Tests are thus suggested for Langmuir's high field theory of cold kathode arcs. Data for the mercury arc indicate that electrons, in sufficient number to produce the necessary positive ions, have energies certainly less than 7 volts at the boundary of the kathode fall. Either the field theory does not apply to the mercury arc, or positive ions are produced by a cumulative process or other complicated means. AUTHOR.

4290. Anode Spots in Low-Voltage Arcs in Helium. K. Yosioka. *Phys. Math. Soc., Japan, Proc.* 13. *pp.* 218–221, *July,* 1931. *In English.*—An investigation was made of the occurrence of anode spots in extremely pure helium. It was found that for the range of pressure from 18 to 10 mm. the spots always appeared when the anode current was raised above 400 mA. They were fainter in colour than in hydrogen. The number of the spots increased with rising pressure and increasing anode current. At pressures below 10 mm. no spots were observed. The spectrum of the spots consists of strong He series lines and weak He band lines, with no trace of H-lines. With a discharge current above 300 mA sounds are heard in a telephone receiver in the anode circuit. When the spots move vigorously about their mean positions the sound is a noise, but when the spots are stable a pure musical tone is heard. Inserting a 0·5-henry choking coil in the circuit practically cuts out the sound, but the discharge features are not altered. It is therefore concluded that there is no direct relation between the spots and the oscillation in the discharge. A. W.

4291. Elementary Processes of Ionisation by Collision of Material Particles. Part I. H. Kallmann and B. Rosen. *Phys. Zeits.* 32. *pp.* 521–544, *July* 15, 1931.—Summarises recent theoretical and experimental work on ionisation by collision. Theories based on classical and wave-mechanical principles are discussed. Some typical experimental methods are described. The results are discussed for ionisation (*a*) in simple atoms and molecules; (*b*) accompanied by excitation of nuclei; (*c*) with formation of several ions; (*d*) by rapid electrons; (*e*) in adsorbed gas layers; and (*f*) in solids. Tables of ionisation potentials of 70 atoms, 31 molecules, 53 ions, and of other valuable data are given. The question of probability of ionisation receives special attention. A section is devoted to the velocities of electrons liberated by ionisation. A full list of references is appended. N. D.

4292. Probability Law of Ionisation by Electron Impact in Mercury Vapour. C. R. Haupt. *Phys. Rev.* 38. *pp.* 282–295, *July* 15, 1931.—An electron-gun type of ionisation tube was devised, capable of high resolving power and having a dull emitter kathode. This apparatus gave a velocity distribution closely approximating to the theoretical Maxwellian distribution and enabled the critical potentials of Lawrence to be checked. The agreement was in general quite good, and the results can thus be regarded as verifying Lawrence's probability law within the limits of experimental error. The values of the critical potentials found were at 10·6, 11·3, 11·7 and 12·1 volts. Additional ionisation potentials were found at 12·3, 12·45, 12·85 and 13·2 volts. A search for critical potentials above 13·2 volts yielded negative results. Evidence is presented to show that the observed critical potentials are a result of the ionisation of metastable atoms. [See also Abstract 2060 (1926).] A. W.

4293. Ionisation of Helium, Neon and Argon. R. L. Womer. *Phys. Rev.* 38. *pp.* 454–456, *Aug.* 1, 1931.—The finding of extra ionisation potentials in mercury and potassium vapours, and more recently in nitrogen and carbon monoxide, suggested the problem of examining the ionisation curves for helium, neon and argon in the region of their normal ionisation potentials. A modified form of the Hertz space charge method was used. Results with this apparatus have shown that, over the voltage ranges examined, there is only one ionisation potential for each of the gases helium, neon and argon. AUTHOR.

4294. Theory and Method of Determination of Size of Ions in the Atmosphere. H. Israël. *Gerlands Beitr. z. Geophys.* 31. 1–3. *pp.* 173–216, 1931.—An investigation of the distribution of the mobilities of ions in the atmosphere is made by obtaining a characteristic curve between current and potential in a cylindrical condenser as air is drawn through it. The mobilities are obtained by double differentiation with respect to potential. Three methods of practical analysis are described. In the first, using free air travelling with a constant velocity, five points are obtained simultaneously. In the others, the points of the characteristic are obtained consecutively, but air in a closed space with a constant number of ions must be used. These give greater resolving power, however, than the first method. The errors and limits of exactness are described and results given, showing that there are groups of ions of a definite size in the air, analogous to bands in a spectrum. H. M. B.

4295. Experiments on Time-Lag in Gasfilled Photoelectric Cells. E. L. E. Wheatcroft. *Phil. Mag.* 12. *pp.* 162–173, *July*, 1931.—An absolute method is described for the measurement of time-lag in a gasfilled photoelectric cell. Further, the general equations which represent the internal behaviour of a cell are derived and shown to be in accord with experiment. The processes taking place in the cell are discussed. F. J. W.

4296. Photoelectric Emission of Thin Films. N. R. Campbell. *Phil. Mag.* 12. *pp.* 173–185, *July*, 1931.—The constitution of the cæsium-silver-oxygen photoelectric kathode has been investigated. The films were formed by heating oxidised silver in cæsium vapour. The changes in emission during the introduction of the cæsium indicate that it undergoes reaction with the oxidised silver so that the final kathode consists of a thin film of cæsium on the products of the reaction. The products are cæsium monoxide and silver, the latter forming an alloy with excess cæsium. Measurements of the thermionic emission show that these kathodes have almost equal values of b but widely different values of A. High A values are accompanied by a low mean photoelectric emission in agreement with Fowler's theory of selective emission. The value of b determined thermionically does not accord with the photoelectric threshold. F. J. W.

4297. Photoelectric E.M.F. in Cuprous Oxide Crystals. H. Dember. *Phys. Zeits.* 32. *pp.* 554–556, *July* 15, 1931.—In cuprous oxide, three photoelectric effects are observed, the external photoelectric effect, the increase in the internal conductivity and an internal photo-E.M.F., which Lange and Schottky trace to the action of a "blocking layer." The author studies this last effect, but in the solid cuprous oxide layers presented by natural cuprite crystals. One of these crystals is held by two corners in a clamp. Illumination in a certain direction gives a current of about 0·01 microampere, but this is changed or even reversed by a different orientation. The author makes several different connections which show that the direction of the incident light is the determining factor. A blocking layer is not excluded, but it leaves some phenomena unexplained. E. E. F. d'A.

4298. Effect of Electric Fields on Emission of Photoelectrons from Oxide Kathodes. W. S. Huxford. *Phys. Rev.* 38. *pp.* 379–395, *Aug.* 1, 1931.—A study has been made of the photoelectric emission obtained at room temperature from the equipotential oxide kathodes commonly employed in radio receiving valves. With a double monochromator, long-wave limits were determined by plotting the currents as a function of the wave-length of the incident radiation. The threshold frequencies decreased with increase in the accelerating potential according to the relation, $\nu = \nu_0 - bE^{1/2}$, in which ν_0 is the "zero-field" threshold and E the electric field at the kathode surface. It is shown that the observed lack of saturation in the photoelectric currents may be ascribed to a decrease of work function with increase of applied field. The tendency to non-saturation is greatest for light of longest wave-length. Calculations show that the photoelectric equation of Houston satisfactorily represents the variation in numbers of emitted electrons with colour of illumination, and with change of threshold. Some comparisons are made of the photoelectric emission and the thermionic currents obtained from the same kathode surface. There is a change in photoelectric threshold with activation. Preliminary measurements of thermionic work functions confirm the theory that in both cases the emission of electrons takes place from the outermost layers of the oxide coating. AUTHOR.

4299. Photoelectric Properties of Mercury Films. D. Roller, W. H. Jordan and C. S. Woodward. *Phys. Rev.* 38. *pp.* 396–400, *Aug.* 1, 1931.—Films of very pure mercury were deposited slowly in a high vacuum on an oxidised iron plate maintained at liquid air temperature. As each film increased in thickness, the photoelectric current excited by each of the mercury arc lines 2537 Å., 2653 Å. and 2700 Å. increased from zero to a maximum value and then decreased to a final constant value. In each case the threshold wave-length at the time of maximum sensitivity was close to 2750 Å. Its final value, that for a thick layer of mercury, was

2730 ± 15 Å.; this did not change even when the mercury was allowed to melt, thus confirming a previous conclusion that the threshold wave-lengths for solid and liquid mercury are the same. There was no indication of a large shift in threshold wave-length at any time during the formation of the films. AUTHORS.

4300. Effect of Adsorbed K+ Ions on the Photoelectric Threshold of Iron. A. K. Brewer. *Phys. Rev.* 38. *pp.* 401–407, *Aug.* 1, 1931.—The photoelectric emissivity of a pure iron filament, which has just previously been used as a kathode for K^+ ions, is increased in direct proportion to the positive ion current, for all surfaces where the computed fraction of the surface covered is $\theta \leq 0\cdot03$. For larger values of θ the emissivity for $\lambda 3022$ and $\lambda 3132$ increases rapidly with θ while $\lambda 2804$ remains proportional to θ until the fraction of the iron covered with potassium exceeds $0\cdot08$. The solution of potassium in the iron beginning above $\theta \leq 0\cdot03$, as well as the vaporisation of potassium by the iron bombardment, prevent the formation of a surface for which θ exceeds $0\cdot10$. The data have been interpreted as indicating that for $\theta \leq 0\cdot03$ every K^+ ion striking the iron remains on the surface as an ion, while for larger values of θ both potassium atoms and ions are present. The increase in the photoelectric current is due both to the lowering of the work function by the presence of the positive ions and to the emissivity from the adsorbed atoms. AUTHOR.

4301. Photoelectric Properties of Zinc Single Crystals. J. H. Dillon. *Phys. Rev.* 38. *pp.* 408–415, *Aug.* 1, 1931.—An experiment is described in which the photoelectric properties of outgassed single crystals of zinc were studied. After treating the emitting surfaces of a crystal with ultra-violet light and thermally evaporating some of the zinc, a stable condition was reached. In this stable condition a difference in the long wave limits of the polycrystalline surface and cleft 0001 face of approximately 260 Å. was observed. The results are discussed with regard to possible sources of contamination and the presence of occluded gas layers. AUTHOR.

4302. Thermionic Valves with Potential Gradient along the Grid. A. lo Surdo. *Accad. Lincei, Atti,* 13. *pp.* 459–462, *April* 12, 1931.—The inevitable potential gradient along the filament makes the electrons impinging upon different parts of the grid have different velocities. The author corrects this by sending an auxiliary current through the grid itself, which he constructs of tungsten wire 0·2 mm. thick and 28 mm. long wound in a spiral coil. In this way he obtains greatly improved characteristics. E. E. F. d'A.

4303. Thermionic Emission from Iron. G. Siljeholm. *Ann. d. Physik,* 10. 2. *pp.* 178–222, *July* 3, 1931.—The positive emission shows a sudden increase at a transition point, similar to that shown by the solubility of hydrogen in iron. The positive emission is probably produced by the diffusion of foreign ions through the metal. In most cases the decay of the emission current with time can be represented by an expression which is the sum of two exponential functions with different constants. This indicates that the foreign ions are mainly derived from two substances. The negative emission shows a sudden decrease at the same transition point. The state of degasification is very important. In certain cases the discontinuity may be in the inverse direction to that obtained with the pure metal. The work of extraction of an electron from pure iron is found to be 4·77 volts. The thermoelectric power of iron also shows a sudden decrease, and the electric conductivity a sudden increase at the same transition point. A theory of the above effects, with which the results are in quantitative agreement, is given. N. D.

4304. Thermionic Properties of Barium Films Adsorbed on Tungsten. H. Nelson. *Physics,* 1. *pp.* 84–93, *Aug.,* 1931.—An investigation has been made of some thermionic properties of a barium film adsorbed on tungsten for various values of θ, the fraction of the surface covered with barium. The experimental tube was so constructed that the measurements could be made on a small area of the filament in order that errors due to lead losses, non-uniformities and voltage drop along the filament might be minimised. A valve electrometer was used to measure the electron currents. The experimental results obtained by Eglin were confirmed, *i.e.*, the thermionic activity of the composite surface was found to increase with θ until an optimum value was reached after which further deposit of barium caused the activity to decrease. As a result of prolonged deposition, a steady value of the activity was reached which did not change appreciably or regularly with further deposition. The change in contact p.d. was found to be directly proportional to the change in T_θ, the absolute temperature of the filament required to give an arbitrarily fixed value of electron emission. It is significant that the factor of proportionality for all values of the activity higher than the steady value reached after prolonged deposition was found to be different from that obtained for the values which were lower. The distribution of velocities of the emitted electrons was found to be Maxwellian for all values of θ. The construction of the experimental tube was found to be unsuitable for studying the effect of field intensity on the activity. Thus the results obtained pertaining to this effect are of little significance. AUTHOR.

4305. Theory of Extraction of Electrons from Metals by Metastable Atoms. H. S. W. Massey. *Cambridge Phil. Soc., Proc.* 27. *pp.* 460–468, *July* 31, 1931.—Referring to his previous paper in which was discussed the nature of the phenomena occurring when electrons are ejected from metal surfaces by the impact of metastable atoms and positive ions [see Abstract 4103 (1930)], the author in the present paper extends the theory. Previously it was shown that electrons may be ejected by excited atoms at considerable distances from the surface, and by considering the case of an excited H atom at the centre of a spherical cavity in the metal, the order of magnitude of the effects to be expected and the velocity distribution of the ejected electrons were determined. In the present paper further calculations are made for the case of a helium atom in a 2^3S state near a metal surface. Formerly no attention was given to the angular distribution of the ejected electrons since the problem was made spherically symmetrical. It is now shown that little error is involved by treating the problem thus. More detailed information is also given on the angular distribution. J. J. S.

4306. Ray Theory of Electric Waves and Dynamics. T. L. Eckersley. *Roy. Soc., Proc.* 132. *pp.* 83–98, *July* 2, 1931.—It is well known that ray methods are only approximate, and the object of this paper is to discover how far such approximations are justified. Hamilton expressed the relations between rays and the corresponding orbits in dynamics. It is shown in the present case that we can interpret the rays as the orbits of a group or packet of waves considered as a particle, moving in a field of force whose potential is proportional to the electronic density. Then the relation between the approximate ray theory in radio transmission and the true wave theory is identically that between the Newtonian dynamics of an electron and Schrödinger's wave theory of it. The wireless ray theory fails when the radius of curvature of the ray becomes comparable with the wave-length, in just the same way as the Newtonian dynamics of an electron fails when the orbit becomes of atomic dimensions comparable with the wave-length of the Schrödinger ψ waves. This analogy between the quantum theory and the transmission of electromagnetic waves in an ionised atmosphere is used to develop approximate solutions of the transmission of wireless waves round the earth. These solutions are based on the approximate phase integral methods of Bohr and Sommerfeld, used in quantum dynamics. The results are used to explain the effect of magnetic storms on short-wave transmission. A. W.

4307. Measurement of Residual Inductance of Potentiometers and Four-Terminal Resistance Coils. N. F. Astbury. *Journ. Sci. Instruments,* 8. *pp.* 221–223, *July,* 1931.—A simple bridge method is described for the measurement of the inductances of potentiometers and four-terminal resistances. The method is virtually one of substitution, the quantity required being deduced in terms of the difference between two readings of a condenser. A few typical measurements are recorded. AUTHOR.

4308. Design of Standards of Inductance and Use of Model Reactors in the Design of Air-Core and Iron-Core Reactors. H. B. Brooks. *Bureau of Standards, J. of Research,* 7. *pp.* 289–328, *Aug.,* 1931. —After a brief discussion of the various uses of reactors and the general characteristics of formulæ for the self-inductance of coils, a number of useful general relations concerning the self and mutual inductance of geometrically similar coils are given with illustrative derivations of some of these relations. Three applications are developed in the remainder of the paper. The first is a simple and straightforward procedure for the design of air-core coils to serve as standards of self-inductance and is believed to be the first procedure for this specific purpose to be published. The second application proposes that the self and mutual inductance of the large current-limiting reactors used in power systems may be advantageously predetermined, or their computed values checked, by laboratory tests made on small-scale models. The third application proposes to use models for the checking or predetermination of the properties of iron-core air-gap reactors. In developing the theory of this application it is shown that such reactors have their desirable optimum performance—that is, minimum power factor—when the relative length of the air gap is such as to make the copper loss equal to the core loss for the desired maximum magnetic flux density in the core. AUTHOR.

4309. Elastic Problem of a Wire-Wound Cylinder. C. Snow. *Bureau of Standards, J. of Research,* 7. *pp.* 331–356, *Aug.,* 1931.—The elastic problem here treated is that of an infinitely long circular cylinder around which is wrapped an endless set of equal wires, equally spaced, with given tension. The deformation in cylinder and wires is found after determining the pressure distribution and the shape and size of the contact surface between a wire and the cylinder. The latter are found by a method which is a natural extension of Hertz's theory of contact. The contact surface is a ring of finite length instead of an infinitesimal ellipse as in Hertz's method so that the integral equation determining the pressure function and its range is in this case a logarithmic potential instead of a Newtonian one. Numerical application is made to measurements on a precision standard of inductance, which is a single layer coil on a porcelain cylinder. It is concluded that errors due to deformation of wire and cylinder will be negligible in the computation of the inductance provided that the over-all diameter is measured after winding. AUTHOR.

4310. Magnetisation of Single Crystals of Cobalt at High Temperatures. K. Honda and H. Masumoto. *Tohoku Univ., Sci. Reports,* 20. *pp.* 323–341, *July,* 1931. *In English. Report No.* 267 *of the Research Inst. for Iron, Steel and other Metals.*—The authors measured the magnetisation of single crystals of cobalt at different temperatures ranging from – 190° to 390° by the ballistic method. The magnetisation at ordinary temperature in the direction of the [0001] axis rises at first rapidly and attains an asymptotic value in a comparatively weak field. As the temperature is raised, the intensity of magnetisation in weak fields increases up to 230°, and then decreases. The magnetisation in the directions of the $[10\bar{1}0]$ and the $[11\bar{2}0]$ axes at ordinary temperature is very difficult, so that even in a field of 10,000 gauss the saturation value is not reached. As the temperature is raised, the magnetisation in these directions becomes easier up to 300°; but above this temperature it does not change appreciably. The saturation value of magnetisation of cobalt crystal at absolute zero has been estimated to be 1446 C.G.S. units. AUTHORS.

4311. Effect of Cold-Working on Magnetic Susceptibility of Metals. K. Honda and Y. Shimizu. *Tohoku Univ., Sci. Reports,* 20. *pp.* 460–488, *July,* 1931. *In English. Report No.* 272. *of the Research Inst. for Iron, Steel and other Metals.*—The effect of cold-working or internal stress on the magnetic susceptibility of metals has not hitherto been systematically studied. The present writers have measured this effect on ten metals belonging to the cubic system, namely, Cu, Ag, Au, Pb, Al, Pt, Rh, Pd, Mo and Ba. The important facts observed are as follows: The relation between the change in magnetic susceptibility and density is linear; the magnetic susceptibility of diamagnetic metals, that is, Cu, Ag, Au, Pb, etc., decreases in a marked degree by cold-working and that of paramagnetic metals, that is, Al, Pt, Rh, Pd, Mo and Ba, also decreases. In the case of copper—a weak diamagnetic metal—its susceptibility changes from diamagnetic to paramagnetic by severe cold-working. These experimental results are satisfactorily explained by Honda's theory of magnetism. AUTHORS.

4312. Magnetic Properties of Copper-Nickel Alloys. E. H. Williams. *Phys. Rev.* 38. *pp.* 828–831, *Aug.* 15, 1931.—The magnetic susceptibility of alloys of copper and nickel in proportions ranging from 0·1 to 70 % nickel have been studied. X-ray photographs of the alloys show that they are a homogeneous mixture of the copper and nickel crystals. Although copper is only weakly diamagnetic it requires 0·8 or 0·9 % nickel to neutralise this diamagnetic effect and 56 % nickel is required before the alloy shows ferromagnetic properties at ordinary temperatures. For amounts of nickel from 1 % up to 30 % the alloy, while paramagnetic in most respects, does not obey any known law of paramagnetism with regard to temperature. As the temperature is increased the susceptibility first increases and then decreases, the maximum occurring in the neighbourhood of the Curie point for nickel. In the case of alloys containing more than 30 % nickel the susceptibility decreases with increase of temperature for temperatures above 20° C. Author.

4313. Magnetostriction of Ferromagnetic Materials. G. Dietsch. *Zeits. f. techn. Physik.* 12. 8. *pp.* 380–389, 1931.—A method is described for increasing the sensitivity and accuracy of determinations. It consists essentially in the use of short wave-lengths (70 m.), small plate distance in the measuring condensers (0·02 to 0·003 cm.) and an increase in the effective length of the test rod (28·5 cm.). It is claimed that the arrangement yields results of an order of two-tenth powers higher than before attained. Details are given fully. Using the apparatus it is shown that electrolytic nickel exhibits strong hysteresis, dependent upon its previous mechanical history. A decrease in the value of M results from the annealing of nickel alloys, due possibly to a break-up of the mixed crystal structure. In the Be-permalloy alloys (0·5 and 1 % Be) no great differences are found, yet in non-corrosive steel, as compared with electrolytic iron, a considerably greater alteration of length is found in the magnetic field. The influence of previous mechanical strains taken above the elastic limit in general causes a decrement of M. The dynamical pre-treatment of the samples leads to no obvious influence on the striction curves. At fields of about 100 gauss, with electrolytic iron there is an initial increase, but with Be-Ni annealed alloy, a decrement results. The method is particularly suitable for the measurement of the effects of small extensions of 1 or 2 % and the results for small and large extensions are compared, the larger extensions showing no appreciable influence on M in contrast with the smaller above mentioned. S. G. B.

4314. Structural Demagnetising Field in Ferromagnetic Bodies. R. Forrer and J. Martak. *J. de Physique et le Radium,* 2. *pp.* 198–204, *June,* 1931.—The hysteresis cycles of ferromagnetic metals are more or less inclined. This inclination varies with the condition as to tempering. The hypothesis of a structural demagnetising field H_s, analogous to the structural demagnetising field of pyrrhotine but incomparably smaller, explains this inclination. A description is given of an experimental method for the determination of H_s. The knowledge of H_s is necessary for the exact determination of the true residual magnetisation, that is to say, in an internal field truly zero. The residual magnetisations thus obtained accord well with the result of calculation based on the hypothesis of magnetic multiplets. J. J. S.

APPARATUS AND INSTRUMENTS.

4315. Photoelectric Integraph. T. S. Gray. *Frank. Inst., J.* 212. *pp.* 77–102, *July,* 1931.—A machine for the purpose of facilitating mathematical solution of problems requiring the evaluation of an integral in which the integrand involves a variable parameter is described in this article. It involves the use of an optical system in which the transmission of light is limited in a definite manner by apertures having the shape of the area under curves representing mathematical functions. The accuracy of the machine itself is from 2 to 5 %. Examples of the use of the device in the solution of the superposition theorem integral and a form of integral equation are given. Its application to other problems including the Fourier transform, correlation analysis, and periodogram analysis is discussed, and its limitations are considered. AUTHOR.

4316. Conditions of Equilibrium in the Wheatstone Bridge for Measurements of Audio- and Radio-Frequency. A. Marino. *Accad. Lincei, Atti,* 13. *pp.* 606–612, *April* 26, 1931.—In measurements of radio- and audio-frequency by means of the Wheatstone bridge, much difficulty arises on account of the capacity of the arms of the bridge towards earth or towards the metallic case in which the bridge is often enclosed. A method of eliminating this difficulty has been indicated by Wagner, which has not yet been generally applied. In the present paper an explanation is given with several diagrams and a full theoretical discussion of a simple method of showing what are the conditions for securing the equilibrium of a Wheatstone bridge in the case when the capacity of the arms of the bridge towards earth are not negligible. J. J. S.

RADIOGRAPHY AND ELECTROPHYSIOLOGY.

4317. Activation of Ergosterol with Radon. R. B. Moore and T. de Vries. *Am. Chem. Soc., J.* 53. *pp.* 2676–2681, *July,* 1931.—Ergosterol can be activated with radon to a degree of potency perhaps 0·01 of that of a good grade of ultra-violet irradiated ergosterol. Stirring the sample while under the influence of the radon increases the speed of activation, but does not increase the potency appreciably. There is no appreciable loss in potency if the activation is carried on to even as much as a twenty-fold excess. There are some decomposition products formed in all cases. AUTHORS.

4318. Nomenclature and Standards for Biologically-Effective Radiation. M. Luckiesh and L. L. Holladay. *J.O.S.A.* 21. *pp.* 420–427, *July,* 1931.—Discusses various proposed units of biologically-effective radiation. W. V. M.

4319. X-Ray Protection. *Bureau of Standards, Handbook, No.* 15. [26 *pp.*], 1931. W. V. M.

4320. Use of Flashing Neon Lamp Circuit in Electrophysiology. W. A. Leyshon. *Journ. Sci. Instruments,* 8. *pp.* 202–204, *June,* 1931.—In physiological experiments involving electrical excitation of nerve-muscle preparations, intermittent potential differences have to be applied to the excitable tissue. This is usually carried out by means of an induction coil or condenser discharges. An arrangement of a flashing neon lamp circuit for the purpose is described, as well as a time marker suitable for use with the circuit. W. V. M.

4321. Physiological Damage and Apparent Death Caused by Electricity. S. Jellinek. *Soc. Franç. Élect., Bull.* 1. *pp.* 662–672, *July,* 1931.—The author recalls the pioneer work of d'Arsonval on the biological effects of electric currents, and it is contended that the consequences of an electrical accident are not burns but mechanical lesions which show a remarkable tendency to spontaneous recovery and absence of pain. The usual mutilating operations are deprecated and new methods of treatment advocated. W. V. M.

CHEMICAL PHYSICS AND ELECTROCHEMISTRY.

4322. Adsorption of a Weak Electrolyte from a Solution of a Neutral Salt. A. Skapski. *Acad. Polonaise Sci. et. Lettres, Bull.* 1*A. pp.* 20–30, *Jan.*, 1931. *In German.*—The adsorption of acetic acid from solutions of a number of neutral salts was investigated. The adsorption agent was " carbo medicinalis " (E. Merck). The adsorption was carried out by shaking the solutions and the adsorbing agent in a stoppered flask at 25° C. The acid was titrated with barium hydroxide solution. The results do not support the view that the influence of salts upon adsorption constitutes a general method for determining activity coefficients. F. J. B.

4323. Porosity of Charcoal and Rate of Attainment of Adsorption Equilibrium. M. Dubinin. *Zeits. f. phys. Chem.* 155. *Abt. A.*2. *pp.* 116–122, *July*, 1931.—The present paper refers to investigations on the rate of adsorption of aliphatic and inorganic acids from their aqueous solutions by charcoals of various porosities and in this way makes clear the influence of time on the inversion phenomenon in the homologous series of aliphatic acids and the series of inorganic acids. The monobasic fatty acids investigated are propionic acid, valeric acid and heptylic acid. The inorganic acids experimented with are HCl, H_2SO_4 and H_3PO_4. J. K.

4324. Nature of the Specific Properties of Surface Fields. Structure of Active Charcoal and Inversion of the Effect of the Heats of Adsorption and Wetting. Part II. B. Iliin and J. Simanow. *Zeits. f. Physik,* 70. 7–8. *pp.* 559–561, *July* 14, 1931.—Debye diffraction photographs for a hydrophobic and a quasi-hydrophilic charcoal are identical and differ from those of graphite. Small quantities of graphite have been added to the hydrophobic charcoal, and it is found that the graphite lines are obtained with a preparation containing only 1 % of graphite. No change in the surface properties of the charcoal is observed, and it is, therefore, concluded that the observed effects [see Abstract 2067 (1931)] cannot be attributed to the presence of graphite. F. J. W.

4325. Static and Dynamic Displacement Theories. Part III. D. Reichinstein. *Zeits. f. Elektrochem.* 37. *pp.* 365–371, *July*, 1931.—The displacement theory [see Abstract 466 (1928)] is shown to satisfy both the purely chemical and physical conceptions of the process of adsorption. The physical conception represents a generalisation of Langmuir's theory, but deviates widely from Langmuir's view in its interpretation of the displacement constant. With the help of the hypothesis of the amount of movement of the solid substance, the kinematically isochronic adsorption isotherms are deduced. A rigid derivation of the dynamic adsorption isotherms is given. T. H. P.

4326. Apparent Volumes of Salts in Solution. Part I. A. F. Scott. *J. Phys. Chem.* 35. *pp.* 2315–2329, *Aug.*, 1931.—The present paper gives the preliminary results of a test of the empirical rule of Masson, namely, $\phi = am^{\frac{1}{2}} + b$, where m is the molality in gm.-mol. per litre; ϕ is the apparent molal volume of a salt in an aqueous solution; a and b are constants, characteristic of the salt involved and also dependent on the temperature. The equation is tested for its ability to represent the experimental variation of ϕ with concentration of alkali halides by comparing the expected additive properties of the constant b and also by comparing experimental and computed values of ϕ in saturated solutions. The theoretical significance of the equation is also briefly considered. J. K.

4327. General Theory of Solutions. R. C. Cantelo. *J. Phys. Chem.* 35. *pp.* 2357–2363, *Aug.*, 1931.—The present paper gives a brief review of the development of the theory of solutions. It is pointed out that the advances made in the theory of solutions and applications of these advances are due to the introduction of a purely mathematical idea into thermodynamics by Gibbs. J. K.

4328. Determination of Micelle Charge. S. Filitti. *Comptes Rendus*, 192. *pp.* 1731–1733, *June* 29, 1931.—Reference is made to the work of Perrin and Marinesco. The method of Marinesco is applied to alkaline solutions of congo red, rose bengal, eosin, as well as suspensions of animal charcoal. It is pointed out that it is possible to measure the granular charge of a non-ionised colloid of known micelle weight by measuring the drop in pH produced in the dispersed medium by the addition of a given quantity of a dissolved body. J. K.

4329. Irreversible Processes in Colloidal Systems and the Theory of Sorption Hysteresis. B. Iliin. *Zeits. f. phys. Chem.* 155. *Abt. A.* 3–4. *pp.* 257–266, *July*, 1931.—The hysteresis met with in the sorption of water by certain colloids is discussed theoretically and equations are put forward to describe the phenomenon quantitatively. F. J. W.

4330. Theory of Lyophilic Colloids. Part II. M. Volmer. *Zeits. f. phys. Chem.* 155. *Abt. A.* 3–4. *pp.* 281–284, *July*, 1931.—The present paper is of a mathematical nature and refers to the calculation of the mean molecular weight and to the influence of the double layer on the formation of colloids. [See Abstract 1912 (1927).] J. K.

4331. Pigment Dispersions. F. A. Steele. *Physics*, 1. *pp.* 101–105, *Aug.*, 1931.—A suitable dispersion of zinc oxide in kerosene has a high yield value and marked plastic properties. A few drops of a dispersing agent added to this mixture largely destroys its plastic properties and greatly increases its fluidity. It is well established that the dispersing agent accomplishes this result by decreasing the interfacial tension and thereby destroying the flocculation of the pigment. In certain cases in paints, however, there is reason to believe an entirely different phenomenon is responsible for yield value and plasticity. Much work with the tools of the physicist is indicated in the solution of this problem. There is much to be done in the study of solid-liquid interfacial tension, adsorption layers, interfacial potentials, and the dielectric properties of colloids before these problems are to be solved. The behaviour of pigments in rubber is also discussed. AUTHOR.

4332. Electric Conductivity and Capacity of Disperse Systems. H. Fricke. *Physics*, 1. *pp.* 106–115, *Aug.*, 1931.—This report refers in particular to suspensions of biological cells. The interior of a biological cell is a well-conducting salt solution, but at its surface polarisation or the presence of a non-conducting membrane obstructs the passage of an electric current, with a resulting low conductivity and high dielectric constant of the suspension. The theory for the passage of a.c. through a suspension of this type is dealt with and experimental work with various kinds of

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suspensions such as cream, wet sand, blood and animal tissue, is described to show the applicability of the theory. The determination of the volume concentration of suspensions, of the form factor of the suspended particles, of the thickness of surface membranes, and of the interior conductivity of living cells, are instances of practical applications. AUTHOR.

4333. Dielectric Behaviour of Disperse Systems. R. Fricke. *Kolloid Zeits.* 56. *pp.* 166–170, *Aug.*, 1931.—Records a series of extensive measurements of the dielectric constants of suspensions and colloid solutions of several oxide-hydrates for the study of their decomposition states, the results being then applied to other systems. H. H. Ho.

4334. Dielectric Properties of Casein Gel. W. Haller. *Kolloid Zeits.* 56. *pp.* 170–176, *Aug.*, 1931.—A method is described in detail for the measurement of the dielectric polarisation of powdery substances, and the data for moist casein gels show that with increasing water content a fairly strong rise in specific polarisation occurs. The latter can scarcely be explained by the dipole theory alone, and is ascribed to the formation of hollow spaces rich in water, which are strongly conducting, embedded in an insulating honeycomb poorer in water content. The latter begin to disappear at about 20 % water content, whence the dielectric polarisation rises with sudden increase of electric conductivity. The structural change above is accompanied by one of plasticity. H. H. Ho.

4335. Dielectric Constant of Albumen Solutions. V. Vlassopoulos and F. Blank. *Kolloid Zeits.* 56. *pp.* 176–179, *Aug.*, 1931.—In order to deduce conclusions as to the distribution of the reactive groups, *viz.*, the amino- and carbonyl-groups at the surface of the albumen molecule, the dielectric constants of seralbumen solutions have been studied under acidic and basic conditions. It is shown that the dielectric constant of seralbumen is equal to that of water and that the reactive groups are symmetrically distributed on the surface. H. H. Ho.

4336. Colloidal Properties of Bentonite Suspensions. H. A. Ambrose and A. G. Loomis. *Physics,* 1. *pp.* 129–136, *Aug.*, 1931.—A study of the swelling and gelling properties of bentonite dispersions has been made in connection with the increasing use of this mineral for drilling oil wells. It is shown that the emulsoid type of colloids present responds to changes in the pH of the dispersion medium with respect to rate of settling, viscosity and swelling, thus behaving as a typical hydrophilic colloid. The curve for per cent of solid matter settled in a definite time as ordinate against the pH shows a maximum at the isoelectric point, with minima on each side of this point, corresponding to the points of maximum adsorption. As the pH is further increased or decreased flocculation begins with increased rate of settling. The viscosity curve is closely related to the rate of settling curve, showing maxima and minima corresponding to the electro-viscous effect. Maximum swelling occurs at approximately the point of maximum viscosity. Methods are given for controlling the swelling of bentonites. Relaxation curves are given for bentonite suspensions and utilised to explain the suspension qualities of these sols for heavy mineral dispersions, such as barytes or amorphous silica. A few applications of bentonite sols to the drilling of oil wells are given. AUTHORS.

4337. Mechanical Twins in White Tin and Zinc. K. Tanaka and K. Kamio. *Kyoto Coll. Sci., Mem.* 14. *pp.* 79–83, *May*, 1931.—A simple method of using a Laue-photograph to determine the orientation of twin bands referred to the mother crystal was applied to the case of mechanical twins in white tin and zinc single-crystals, and the twinning planes were found to be (331) and ($10\bar{1}2$) respectively. AUTHORS.

4338. Elasticity and Fatigue of Metals. G. Colonnetti. *Pont. Accad. Sci., N. Lincei, Mem.* 15. *pp.* 345–362, 1931.—A description of experiments made to determine the effect on metals of a large number of repeated pulsating loads. A special machine was developed, and is here described in some detail, by which the required pulsations can be applied to the test sample at a frequency of about 6 per sec., and the deformation measured at the same time with great accuracy. The author points out that he has arrived so far at no final conclusions, owing to relative inaccuracy of his measuring instruments. There are strong indications, however, that certain materials will show a series of positive hysteresis curves, indicating a release of energy by the material itself. This he accounts for by the material being in an unstable condition. After a large number of pulsations have been applied, and the hysteresis curve has assumed its final form, it is noted that this effect is not repeated, even after complete recovery, and this is put forward as an indication that the material has reached a stable condition. L. B. F.

4339. Properties of Silicon Steel. Tamura. *Rev. de Mét.* 28. *pp.* 405–416, *July,* 1931.—The mechanical and physical properties of silicon steel were investigated. The steel contained: $C = 0{\cdot}15$, $Si = 0{\cdot}8$ to $1{\cdot}2$, $Mn = 0{\cdot}8$ to $1{\cdot}0\,\%$. Annealed silicon steel had the same microstructure as carbon steel, but the grain size increased with the silicon content. The presence of 1 % of silicon increased the elastic limit. The resistivity increased with the silicon content, and the permeability increased with the silicon content at low inductions, and diminished at high deductions. The resistance to corrosion was diminished by increase in the percentage of silicon. Constructional silicon steel had a higher elastic limit, tensile strength and hardness than the usual mild steel. F. J. B.

4340. Calcium-Bismuth System. E. Kurzyniec. *Acad. Polonaise Sci. et Lettres, Bull.* 1*A. pp.* 31–58, *Jan.,* 1931.—The equilibrium diagram of the Ca-Bi system is determined by means of thermal analysis data. The results show the existence of two compounds, Ca_3Bi_2, melting at 928° C., and $CaBi_3$ which decomposes at 507° C. into the first compound and fluid melt, $CaBi_3 \rightleftarrows Ca_3Bi_2 + \text{melt}$. Two eutectics exist, one consisting of nearly pure bismuth, which solidifies at 270° C., and a second one which solidifies at 786° C. and consists of 88 % (atomic) of calcium. The heat of formation of Ca_3Bi_2 is estimated at $51{\cdot}6 \pm 0{\cdot}4$ cal. F. J. B.

4341. Equilibrium Diagram of the Tin-Antimony System and the Crystal Structure of the β-Solid Solution. K. Iwasé, N. Aoki and A. Ôsawa. *Tohoku Univ., Sci. Reports,* 20. *pp.* 353–368, *July,* 1931. *In English. Report No.* 269 *from the Research Inst. for Iron, Steel and other Metals.*—The equilibrium diagram of the Sb-Sn system has been revised by the differential thermal and X-ray analyses and also by using electric resistance and microscopic methods. The main point of the present investigation lies in the determination of the nature of the change occurring in alloys containing 30–70 % Sb at a temperature of about 320°. From the results obtained, it has been concluded that this change is due to the allotropic transformation of the β-solid solution, the crystal lattice of which has been determined as a simple cubic which is a very rare example among the intermetallic compounds. AUTHORS.

4342. Absorption of Hydrogen during Solution of Iron. E. Liebreich. *Zeits. f. phys. Chem.* 155. *Abt.A.* 2. *pp.* 123–142, *July*, 1931. The corrosion of iron in an atmosphere of hydrogen was studied in order to examine the conclusions of Evans as to the influence of oxygen on the potential differences. The influence of the products of corrosion is explained on the theory that diffusion of the hydrogen through the layer of hydroxide on the surface of the iron is retarded, and hence the pressure at which the hydrogen is liberated is increased. This view is supported by experiments in which iron was covered by a layer of fine glass powder, and the iron corroded in $0 \cdot 1N$ sulphuric acid in an atmosphere of hydrogen. It is also shown that the kathodic overpotential is lower on a corroded iron surface than on a fresh one, and this is in harmony with the explanations advanced. F. J. B.

4343. Absorption of Nitrogen by Iron. A. Sieverts. *Zeits. f. phys. Chem.* 155. *Abt.A.* 3–4. *pp.* 299–313, *July*, 1931.—The absorption of nitrogen by α, β-, and γ-iron has been studied. At constant temperature the amount of nitrogen absorbed by γ-iron is proportional to the square root of the pressure. F. J. W.

4344. Electrolytic Coating of Metals with Lead Peroxide and its Anti-Corrosive Properties. N. Isgarischew and A. Kusnezowa. *Zeits. f. Elektrochem.* 37. *pp.* 359–362, *July*, 1931.—A comprehensive study of the conditions for successful deposition of PbO_2. The bath recommended is: water 1 l., NaOH 40 gm., Pb 10·5 gm., resorcin 0·001 %, to be used at a temperature of 60° C. with a current density 0·003 ampere per sq. cm. and 1 to 1·2 volts between electrodes 5 cm. apart. Tannin is almost as good as resorcin. Directions are given for the preparation of the lead salt. J. H. A.

4345. Rate of Dissolution of Marble in Acids. W. Jacek. *Acad. Polonaise Sci. et Lettres, Bull.* 2*A.* *pp.* 117–142, *Feb.*, 1931. *In German.* The rate at which balls of marble dissolve in dilute acetic and hydrochloric acids has been measured at room temperature and found to be in accord with the following equation, $-dr/dt = \rho_0(a^3 - r_0^3 + r^3)/a^3$, where r_0 and r are the radii at the beginning and end of the time t, a is the radius of a sphere which for complete solution utilises the whole of the acid, and ρ_0 is a velocity constant. It is found that the rate accelerates in HCl and strong acids as compared with that in acetic acid and probably depends on the conditions of evolution of the CO_2, and on the particular effect of the Ca ions. It is shown that the velocity constant is independent of the dimensions of the sphere dissolved and also of the volume of the acid used, but is proportional to the concentration of the respective acid. H. H. Ho.

4346. Formation and Decomposition of Ammonia in H.F. Glow Discharges. R. Rinkel. *Ann. d. Physik*, 10. 2. *pp.* 129–142, *July* 3, 1931.—Referring to a paper by Alsfeld and Wilhelmy [see Abstract 2103, (1931)], the author points out that a similar investigation on this subject appeared earlier (1929) in the form of a dissertation by Schäfer (Cologne). The latter paper is discussed in detail and the results are compared with those obtained by Alsfeld and Wilhelmy. H. L. B.

4347. Dissociation of Water in the Glow Discharge. E. G. Linder. *Phys. Rev.* 38. *pp.* 679–692, *Aug.* 15, 1931.—The theory that ionisation in the dark space increases exponentially with distance from the kathode, is applied to the dissociation of water vapour. Experimental results are given, which it is shown can be explained quantitatively if the total energy of the electrons generated in the dark space is taken to be $\int_0^s e(V_1 - V)dn$, where S is the width of the dark space, V_1 is the total kathode potential drop, V is the space potential, and n is the number of electrons per element of volume, the exponential increase of which is given by Townsend's equation. The experimental data include measurements of the rate of dissociation for currents from 1 to 28 mA, electrode spacings from 1 to 9·75 cm., and a pressure of 0·75 mm. of mercury, also measurements of the kathode potential drop and the width of the Crookes dark space. Possible reaction mechanisms are discussed. The net energy per dissociation has an almost constant value of 11 volts, whereas the amount of dissociation ranges from 4·78 to 5·90 molecules per electron in the dark space and negative glow, depending upon the magnitude of the kathode drop. Probe measurements in the positive column give an electron density of $7 \cdot 95 \times 10^7$ electrons per $cm.^3$, and an average energy of 3·71 volts per electron. The probability of dissociation by an electron in the positive column having an energy greater than 7·6 volts, is computed to be 0·00115. AUTHOR.

4348. Catalytic Studies by Means of Raman Spectra. H. v. Euler and H. Hellström. *Zeits. f. phys. Chem. Bodenstein-Festband, pp.* 731–736, 1931.—Observations of Raman spectra are used to investigate the activation of molecules. Two methods are employed. In one the two reacting liquids are led into the observation tube by opposing side-tubes, and at such a speed that the reaction proceeds as far as possible in the most brightly illumined part of the observation vessel. In the second, two liquids not directly miscible are let into the tube, so that one layer lies above the other, and the light is concentrated on the interface. Interdiffusion proceeds slowly, and the spectrum is broken up laterally into three strips, due to the lower and upper liquids and the interface region. In the first method, 440 gm. KOH were dissolved in 570 c.c. of water, and 2200 c.c. of alcohol were added. This solution was mixed in the observation tube with 800 c.c. ethyl acetate. No interesting lines were observed. In the second method, 500 gm. KOH were dissolved in 500 c.c. water, and formed the lower layer, while the upper layer was formed of equal parts of ethyl acetate and water. The temperature was raised to 70° C. In the middle part of the spectrum, a slight shift was found in the line 1050 $cm.^{-1}$, and this is thought to be due to activation. A. C. M.

4349. Ground-Frequency and Chemical Decomposition. E. Cremer and M. Polanyi. *Zeits. f. phys. Chem. Bodenstein-Festband, pp.* 770–774, 1931.—From the magnitude of the heat of activation in the dissociation of HI, it can be concluded that it is associated with a loosening of the molecule. In the Raman effect the same thing takes place in the liquefaction of binary gases, and is evidenced by a decrease in the ground-frequency. In this paper an attempt is made to calculate this decrease on the basis of homopolar interaction using London's theory. The observed shifts are, however, greater than those calculated, so it is uncertain whether the explanation assumed is the correct one. A. C. M.

4350. Equilibria in Gas-Water Systems Forming Electrolytes. O. M. Morgan and O. Maass. *Canad. J. of Research*, 5. *pp.* 162–199, *Aug.*, 1931.—The data and theoretical treatment contained in this paper are the continuation of a series of researches instituted to investigate the equilibria existing in certain gaseous-aqueous systems. In this work the vapour pressures and electrolytic conductivities of aqueous solutions of SO_2, CO_2 and NH_3 have been measured with greater precision than ever before over a temperature range from 0° to 25° C. and over a concentration range where their respective vapour pressures do not exceed one atmosphere. From the data thus derived, equilibria relations have been calculated and certain changes have been made in the mode of theoretical procedure involved in this type of calculation. With regard to the equilibria existing in the three systems, the conclusions drawn may be summarised as follows: Practically all of the NH_3 is in the combined form and practically all the CO_2 exists as free CO_2 in the aqueous solutions in the temperature range investigated. The amounts of free and combined SO_2 are of the same order of magnitude and the relative amount of combined and free SO_2 can be calculated approximately, the latter increasing markedly with rising temperature. The true dissociation constant can therefore be found for ammonium hydroxide, can be estimated for sulphurous acid, but cannot be calculated for carbonic acid from the available data. AUTHORS.

4351. Heat of Dissociation of Oxygen Determined from Thermal Conductivity. E. Jenckel. *Zeits. f. phys. Chem.* 155. *Abt. A.* 2. *pp.* 100–108, *July*, 1931.—The heat of dissociation of oxygen was determined by measuring the current consumed by a rod of a mixture of zirconium and yttrium oxides 92·5 % and 7·5 % respectively, in oxygen and nitrogen at different temperatures. The energy consumption in oxygen was found to increase at 2450° Absolute as compared with that consumed in nitrogen. From the difference between the two consumptions, the heat of dissociation was calculated and found to be 120 k.cal., and the degree of dissociation was then obtained by the aid of the chemical constant. F. J. B.

4352. Heat of Dissociation of Iodine. W. G. Brown. *Phys. Rev.* 38. *pp.* 709–711, *Aug.* 15, 1931.—New measurements of the visible absorption bands of iodine in the immediate neighbourhood of their convergence have led to a revised value for the heat of dissociation, 1·535 ± 0·001 volts, which is in satisfactory agreement with chemical data. AUTHOR.

4353. Photochemical Formation of Phosgene. H. J. Schumacher and G. Stieger. *Zeits. f. phys. Chem.* 13. *Abt. B.* 3. *pp.* 157–189, *July*, 1931.—The conditions under which the Cl atoms are removed by bimolecular reaction in the gas phase or by diffusion on the walls of the containing vessel have been examined. At room temperature and in vessels of moderate size the equation $dCOCl_2/dt = k\sqrt{I_{abs.}}[Cl_2][CO]^{\frac{1}{2}}$ is valid at pressures up to 100 mm., and the Cl atoms disappear according to the equation $COCl + Cl \rightarrow CO + Cl_2$. At low pressures (below 30 mm.) or with an extremely large surface the equation becomes $dCOCl_2/dt = kI_{abs.}[Cl_2][CO]$, and the Cl atoms disappear as a result of diffusion on the surface; this type of reaction occurs at temperatures above 250° C., owing to the low phosgene concentration and the increased velocity of diffusion. The influence of blue light on a mixture of CO, Cl_2 and O_2 has been studied. The formation of CO_2 proceeds according to the equation $dCO_2/dt = k\sqrt{I_{abs.}}[CO]^{\frac{1}{2}}$ under conditions such that the Cl atoms recombine in the gas phase, and according to the equation $dCO_2/dt = kI_{abs.}[CO]^{\frac{1}{2}}$ when recombination takes place on the walls of the vessel. The influence of the total pressure, the size of the vessel, and the presence of other gases has been studied. The inhibition of the formation of phosgene by oxygen and the disappearance of this effect at higher temperatures has been explained. H. F. G.

4354. Electrolytic Investigation of Single Crystals of Zinc. K. H. Kreuchen. *Zeits. f. phys. Chem.* 155. *Abt.A.* 3–4. *pp.* 161–198, *July,* 1931.—Single crystals of zinc were prepared by Bridgman's method and potential measurements were made. The behaviour of single crystals was observed in the Daniell element, and the potential of the single crystal was measured against the normal cadmium amalgam electrode. It was found that a potential of about 30 millivolts existed between a freshly cleaved zinc crystal and the poly-crystal metal. The conception of the "surface potential," "characteristic potential" (eigenpotential) and "equilibrium potential" is discussed, in relation to the theory of crystal growth, proposed by Kossel. By the use of capillary vessels for the containers of the electrolyte of the galvanic elements, the measurement of the potentials of single crystal elements was rendered possible. F. J. B.

4355. Becquerel Effect. Part IV. C. Winther. *Zeits. f. phys. Chem.* 155. *Abt.A.* 3–4. *pp.* 225–237, *July,* 1931.—The preparation of copper oxide electrodes by thermal and electrolytic processes is described. The oxide layer was obtained of considerable thickness. The similarity of behaviour between the true and artificial electrodes, described in previous papers [see Abstract 4035 (1931)], is confirmed. The various factors affecting the polarisation of the electrode, potential, current strength, current distribution, internal resistance, and the velocity with which the characteristic values were assumed, and the form of the discharge curve, were determined. F. J. B.

4356. Leclanché Cells. A. Keller. *Zeits. f. Elektrochem.* 37. *pp.* 342–348, *July,* 1931.—The behaviour of the Leclanché cell during discharge is studied, and the solution was varied from acid to neutral to alkaline. The reactions which cause the production of the current are discussed. The theory of Liebenow of the lead accumulator is applied to the Leclanché cell and to a considerable extent was substantiated. The potential of manganese dioxide in alkaline and neutral electrolytes was considered as that of an oxygen electrode in conformity with the theory of the cell. F. J. B.

4357. Electrodeposition of Silver from Argento-Cyanide Solutions. Part II. S. Glasstone and E. B. Sanigar. *Faraday Soc., Trans.* 27. *pp.* 309–312, *July,* 1931.—The effects of additions of potassium cyanate to argento-cyanide solutions containing 1·5*N* carbonate were studied. The concentrations used were greater than 0·1*N*, and the additions resulted in the production of remarkably uniform microcrystalline deposits of silver. The change in the nature of the deposit was accompanied by a decrease in kathodic polarisation. Brightening agents, such as carbon bisulphide, were found to lower the polarisation. High kathodic polarisation favoured the formation of matt deposits of silver from argento-cyanide solutions, and bright deposits were obtained when the polarisation was low. [For Part I see Abstract 1689 (1930).] F. J. B.

4358. Measurement of the Tension of Electrolytic Deposits of Metals. C. Marie and N. Thon. *Comptes Rendus*, 193. *pp*. 233–236, *July* 27, 1931.—Previous work on the mechanical deformation of base metals by the metallic deposit on the surface, is continued and extended to a determination of the magnitude of the forces which bring about the deformation. The forces and pressures were calculated for deposits of nickel, obtained by the electrolysis of solutions of nickel sulphate on platinum, smooth and matt, polished silver, polished and matt copper, polished iron, nickel and tantalum, and matt aluminium. [See Abstract 4044 (1931).] F. J. B.

4359. Electrolytic Production of Metallic Antimony from its Ores. N. A. Isgarischew and S. A. Pletenew. *Zeits. f. Elektrochem.* 37. *pp*. 363–365, *July*, 1931.—Using an iron kathode and a solution of antimony trisulphide or antimony glance in 10 % NaOH solution, a dense deposit of antimony may be obtained, but the current yield gradually decreases owing to the anodic formation of polysulphides. This effect may be counteracted by addition of KCN to the bath and by enclosing the anode in an earthenware cylinder. The current density employed was 200–250 amperes per sq. m., the voltage being 2·3–3 and the temperature 65° C. Current yields averaging 75 % were obtained. When the ore contains small proportions of arsenic, this is not deposited in appreciable amount with the antimony. T. H. P.

4360. Effect of Voltage on the Conductivity of Strong and Weak Acids. M. Wien. *Phys. Zeits*. 32. *pp*. 545–547, *July* 15, 1931. *Paper read before the Deut. Phys. Gesell., Jena, May–June*, 1931.—The voltage effect for sulphuric acid rises from 0·8 % at 100,000 volts to 1·4 % at 200,000 volts, and is approximately the same for all dibasic strong acids. For weak acids the effect is 5–10 times greater, and cannot be entirely explained in terms of the ionic atmosphere or the decrease of hydration of the ions produced by ionic bombardment; it is probably caused by an increase of the number of ions as a result of the bombardment. Measurements with acetic and mono- and di-chloracetic acids show the effect to decrease rapidly with increase of the degree of ionisation of the acid. Data are also given for hydrochloric acid, propionic, tartaric and amino-acetic acids. The calculation of the degree of ionisation from the voltage effect is illustrated by reference to measurements with potassium iodide and lithium bromide. H. F. G.

4361. Dissociation of Strong Electrolytes. Part IV. M. B. Jacobs and C. V. King. *J. Phys. Chem*. 35. *pp*. 1922–1930, *July*, 1931. —In this paper, a continuation of Part III [see Abstract 2123 (1931)], the authors discuss critically the evidence in favour of complete dissociation offered by : (1) crystal structure data; (2) transference number and conductance; (3) certain electrical cells; (4) some of the experimental data which have been compared with the Debye-Hückel theory; and (5) additivity of properties. Under (1) it is shown that the enormous difference between such substances as the hydrogen halides and the common salts, all of which take equal places in the complete dissociation theory, make it quite evident that the previous history of the electrolyte is of questionable significance with respect to its dissociation in water. The data under (2) are considered unimportant in view of the multitude of factors which may influence ion mobilities and transference numbers and the diversity of opinion in interpreting experimental results with respect to complex ion formation. Under (3) Brönsted's results are shown to be suitable for the determination of activity ratios, but not degrees of ionisation or dissociation. The Debye-Hückel theory (4) seems to be obeyed as a limiting law over a small range of concentration of strong electrolytes in solvents with a small range of dielectric constants and ionising powers. Too little is known of the deviations to decide what rôle lack of complete dissociation plays. The data under (5) afford no convincing evidence for or against the theory. H. H. Ho.

4362. Interionic Attraction Theory of Strong Electrolytes. H. Falkenhagen. *Rev. Modern Physics*, 3. *pp.* 412–426, *July*, 1931.—A discussion of this question under the headings: introduction; significant ideas of the Debye theory; theory of conductance in the stationary case developed by Debye-Hückel-Onsager; frequency dependence of the electrical conductance and of the dielectric constant; Wien effect; theory of viscosity, and general remarks. T. H. P.

4363. Energy of Solvation and Distribution Coefficient. H. Hammerschmid and E. Lange. *Zeits. f. phys. Chem.* 155. *Abt.A*.2. *pp.* 85–99, *July*, 1931.—The work of Fredenhagen on electrolytic solution forces [see Abstract 2515 (1931)] is critically discussed. The data on distribution coefficients of neutral and charged solution components are reviewed, and Fredenhagen's conclusions are discussed in the light of these data. F. J. B.

4364. Electrostriction. A. L. T. Moesveld and H. J. Hardon. *Zeits. f. phys. Chem.* 155. *Abt.A*. 3–4. *pp.* 238–256, *July*, 1931.—The volume change which takes place when electrolytes are dissolved is ascribed to the electrical charges on the ions in the solution. In the case of complex cobalt compounds the volume change is definite. The change of acid amides into ammonium salts of the corresponding fatty acids was accompanied by a definite change of volume, which was considered to be partially due to the ionic charge. The contraction in volume was determined for the first three members of the series of fatty acids. An instance of the solution of a salt, accompanied by a considerable volume change, but without the formation of ions, was also studied. It was found that electrostriction decreased at high pressure. The hydration of a number of salts was calculated from the experimental data. F. J. B.

4365. Electrical and Mechanical Conditions around a Dissolved Ion. C. K. Ingold. *Chem. Soc., J. pp.* 2179–2190, *Aug.*, 1931.—The problem discussed is the calculation of the effect of the radially oriented and attracted solvent molecules surrounding an ion on the local electrical conditions, and this of necessity includes a consideration of the local mechanical conditions. H. H. Ho.